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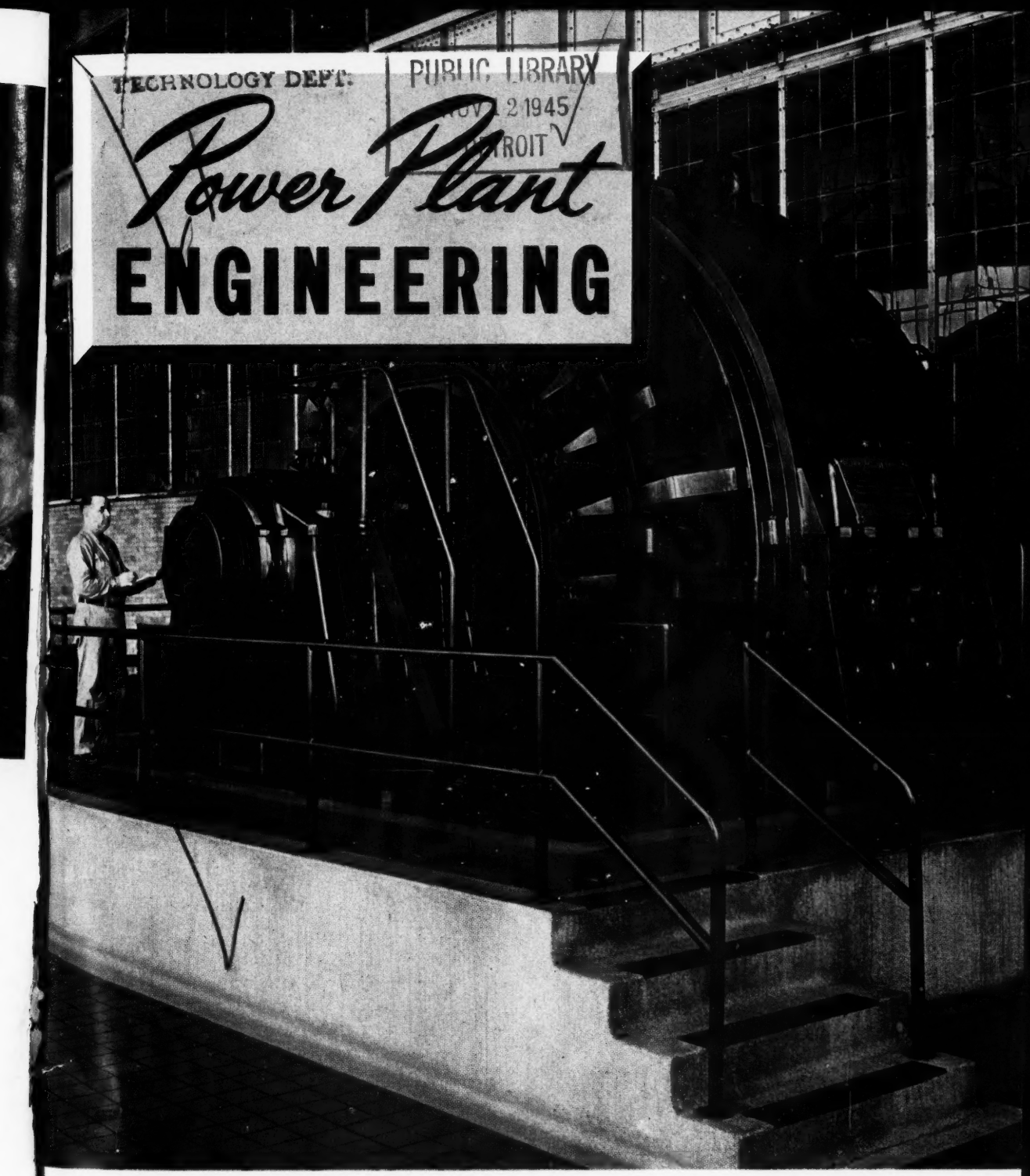
Power Plant ENGINEERING



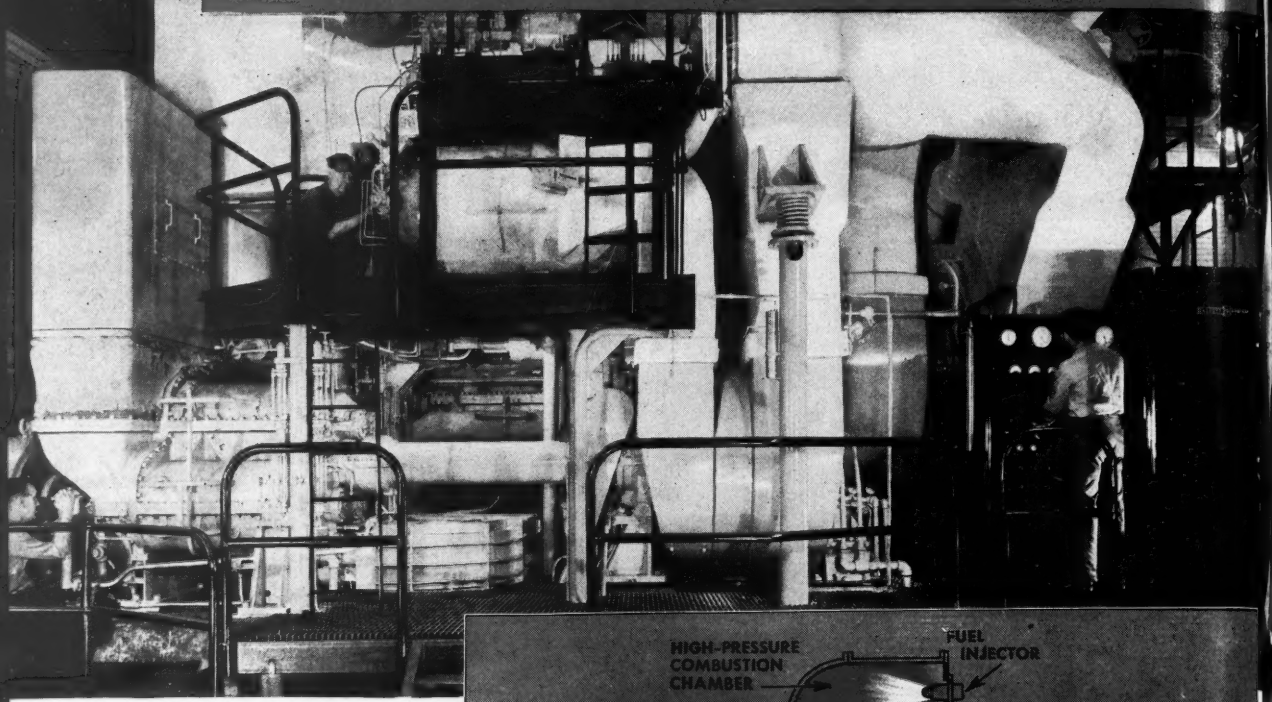
THE POWER ENGINEERING AND MAINTENANCE MAGAZINE FOR EVERY INDUSTRY

OCTOBER • 1945

Features

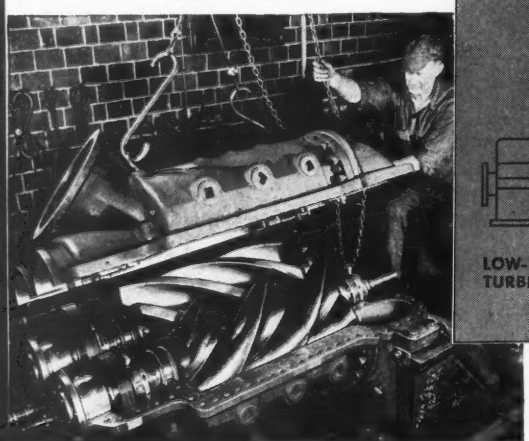
WAR-TIME POWER POOLING • 1945 ADDITION AT ROSSFORD PLANT OF LIBBEY-OWENS-FORD • TRAINING OF PRACTICAL ENGINEERS • METHODS OF CONDENSING REFRIGERANTS • HOW TO TEST WATER • ATOMIC ENERGY • CONTENTS PAGE 5

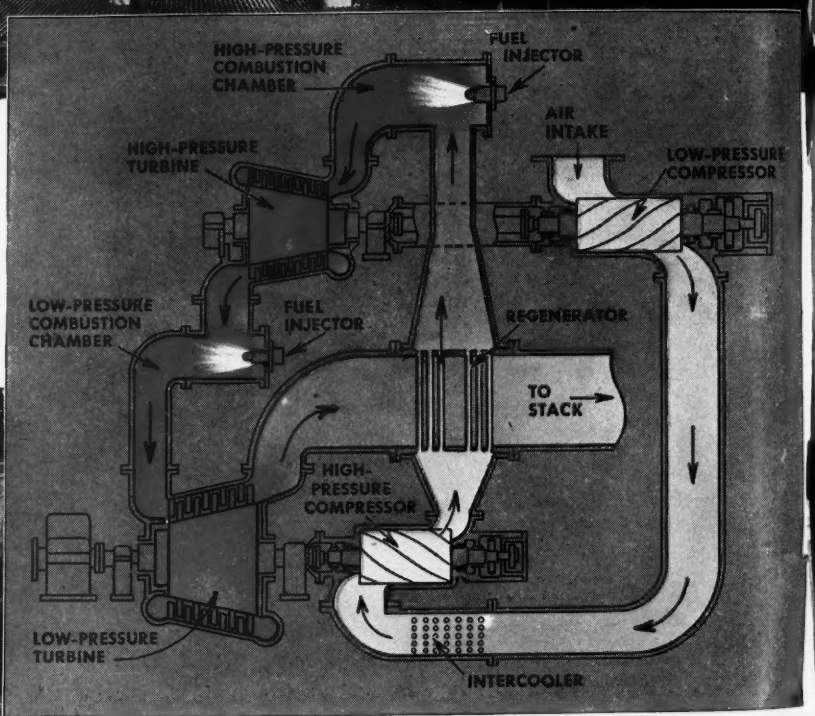
Not a dream of the future



Side view of the first marine propulsion gas turbine and first complete gas turbine power plant to operate in this country.

One of the compressors which were specially developed for the Elliott Gas Turbine. This is a 12,500-cfm unit, positive in operation, delivering a steady flow of compressed air independent of discharge pressure.





Schematic drawing showing heat cycle and operating principle of the Elliott Gas Turbine. The arrangement includes two compressors of special design, two combustion chambers, two turbines, a regenerator and intercooler. The only valves in the entire cycle are on the fuel spray system and intercooler.

ELLIOTT COMPANY

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but a reality of today—

ELLIOTT GAS TURBINE

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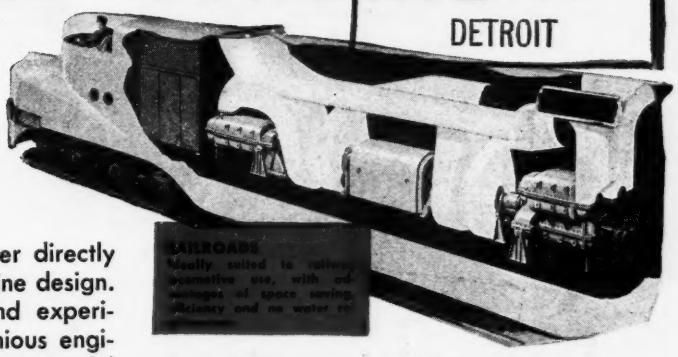


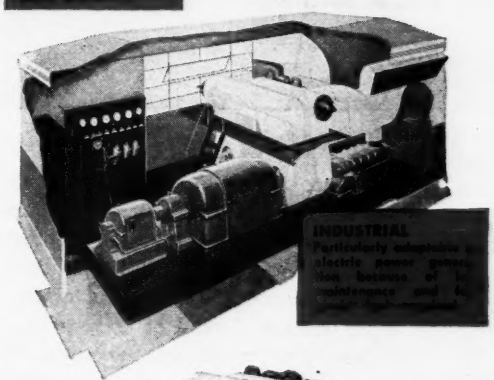
RAILROADS
Ideally suited to railroad locomotive use, with advantages of space saving, efficiency and no water re-

IT'S HERE, NOW—this new prime mover that engineers everywhere have been looking for, that a number of large builders of heavy equipment have sought to develop. The new power unit that turns fuel into power directly without steam equipment or reciprocating engine design. Elliott Company, after years of research and experimentation, marked by characteristically ingenious engineering skill, has built and operated the first successful gas turbine for ship propulsion ever developed. The Elliott gas turbine plant is in production.

Further developments and improvements are naturally to be expected. But the *tough job is done*—there remains now the task of applying this new Elliott prime mover to the various needs of industry and transportation. A few of these applications have been worked out in their probable forms, as illustrated.

PROCESS
Exceptionally applicable to the process industries — petroleum refining, synthetic rubber, chemicals — because of by-product

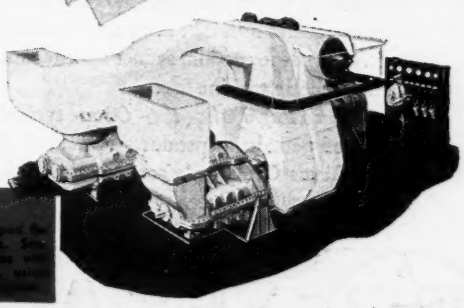
Some of the characteristics and vital data of the Elliott Gas Turbine as established in the present unit, will be of interest . . . horsepower—2500 . . . overall efficiency —29 percent (32 or 34 percent anticipated in later models . . . weight—30 pounds per horsepower (expected to be 20 pounds in later models) . . . cubic area—3½ feet per horsepower (probably will be 1 cubic foot or less in later models) . . . fuel—medium grade fuel oil. Lower grades and powdered coal a probability.



INDUSTRIAL
Particularly adaptable to electric power generation because of low maintenance and

The Elliott Gas Turbine is not a dream of future low cost and limitless power . . . It is a thoroughly practical development, utilizing natural thermodynamic and physical laws with which every engineer is familiar. The gas turbine is here, now—Elliott Company's latest and one of its many important contributions to the power industry.

For further information ask for the Gas Turbine issue of POWERFAX.



MARINE
Already developed for ship propulsion. Several installations will soon be made, using

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"GAS TURBINE

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HEADQUARTERS"

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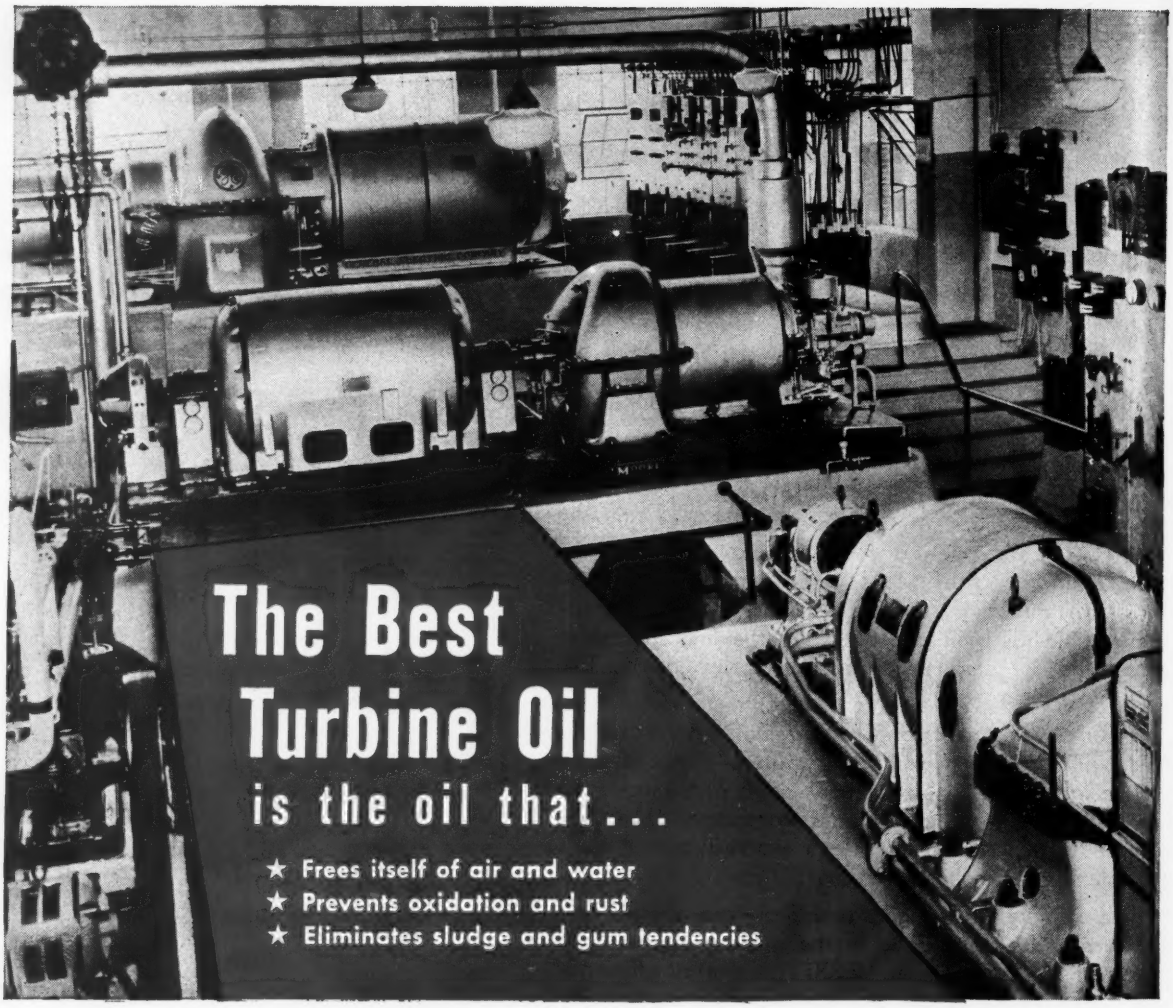
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Turbine Oil
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★ Prevents oxidation and rust
★ Eliminates sludge and gum tendencies

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For suggestions on the proper care of oil and maintenance of turbine systems, call on Texaco Lubrication Engineering Service, available through more than 2300 Texaco distributing plants in the 48 States. Get in touch with the nearest one, or write to The Texas Company, 135 East 42nd Street, New York 17, N. Y.

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FOR ALL TURBINES

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Power Plant ENGINEERING

October 1945

VOLUME 49—NUMBER 10

Cover: This reversible blooming mill motor is used to drive main rolls of massive 44-in. Riverside blooming mill in the Ford Motor Company's steel rolling mill. This reversing main drive motor, largest in the hot strip mill motor room, is a 7000 hp, 50-120 rpm unit operating on 750-v direct current. Since being placed in operation in September, 1935, the motor has run continuously on a 24-hour-day, seven-day week schedule.

Photo, Ford Motor Company

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Contents of back issues of Power Plant Engineering will be found in Industrial Arts Index on file in Public Libraries.

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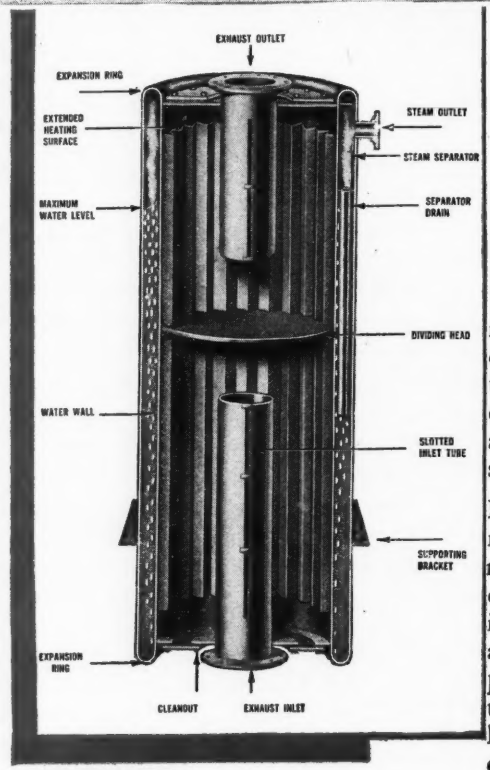
PUT EXHAUST HEAT TO WORK WITH

MAXIM HEAT RECOVERY SILENCERS

There are few industrial plants that would knowingly throw away fuel, and yet many do just that when they allow engine exhaust heat to escape without making use of it. Maxim Heat Recovery Silencers utilize exhaust heat to produce steam or hot water for heating or processing operations. They combine in one unit effective silencing of exhaust noise, spark arresting (where necessary) and efficient heat recovery.

From an efficiency point of view, the value of using Maxim Heat Recovery Silencers is obvious. Engine exhaust must be silenced as a matter of good public relations. The use of Heat Recovery Silencers accomplishes this and, in addition, produces "fuel-free" steam or hot water.



For silencing without the heat recovery feature, Maxim makes silencers for internal combustion engine exhaust or intake, steam engine exhaust, air compressor intake, vacuum pump discharge, blower intake and discharge, high velocity steam, air or gas discharge. Engine exhaust silencers available with or without spark arrestor. Bulletins on request.

Write for Bulletin

Bulletin WH-101 is an eight page illustrated folder showing various types of heat recovery silencers and also practical working hook-ups. A copy will be sent promptly on request.

THE MAXIM SILENCER COMPANY • 89 HOMESTEAD AVE., HARTFORD, CONN.

ARMY E NAVY

MAXIM

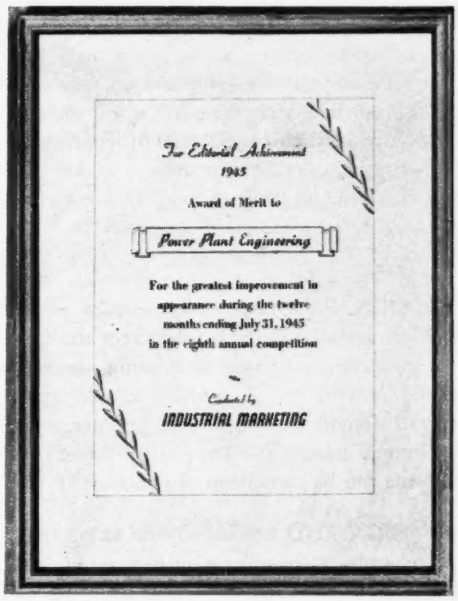
Front Lines

YOUR POST-WAR PLANE is here, says Ethyl News, giving details in its June issue. First new private planes, forthcoming this month, will be much like pre-war types. It will take three or four years' production of these to make up the back demand. After that the really new planes, incorporating the war-time developments, will begin to appear. After that, perhaps in five or ten years, will come the period of full development—the personal helicopter, the roadable plane, the jet-propelled plane. In the immediate first stage, it looks as though the personal plane operator will have to pay $600 to $1000 per seat—probably nearer the latter—for his air vehicle as compared with perhaps $200 per seat for his post-war automobile. But a de luxe job will cost much more.

NON-HYDROCARBON FUELS have been studied, as part of an investigation of substitute motor fuels, by the National Bureau of Standards, U. S. Department of Commerce. A study was made by Donald B. Brooks of the comparative power, thermal efficiency, and combustion performance of a series of these non-hydrocarbon fuels and of a reference gasoline. The non-hydrocarbons used in forming either neat or blended fuels, included ethyl alcohol, diethyl ether, acetone, and butanol.

PROPOSAL for a federally-sponsored plan to carry out a nationwide program of sewage disposal and sewage recovery was recently made by Francis Chilson before a meeting of various Rotary Clubs in Connecticut. Mr. Chilson cited many interesting points in favor of such a plan from both economic and social points of view. However, he did not mention one factor that frequently assumes considerable importance in sewage disposal and recovery operations: the generation of power from waste gases. For example, see the article Gas Engine Experience in Sewage Service by Mackin and Gottlieb, POWER PLANT ENGINEERING, April, 1943.

UNUSUAL APPROACH to the use of engineering services in post-war planning was proposed by Edwin J. MacEwan, executive vice president of the New Haven Chamber of Commerce before the New Haven Chapter of the American Society of Tool Engineers recently. He proposed that the society should appoint representatives to serve on a committee composed of representatives of all types of engineering. The group would be a sub-committee of the Council for Economic Development, meeting monthly to consider any problems that may have developed with any of the 750 highly diversified industries located in the New Haven metropolitan area. MacEwan does not propose that this sub-committee should compete with established consulting engineers, but rather would discuss the problem with the manufacturer to determine in just which field or fields of engineering the solution could be found.


The Editorial Achievement
1945
Award of Merit to
Power Plant Engineering
For the greatest improvement in appearance during the twelve months ending July 31, 1945 in the eighth annual competition
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LOOKING FOR A LADDER? You might find it in a complete engineering graduate training course, permitting exploration by the graduate engineer of production, sales, research, design, field work, administration and many other elements of industrial operation, outlined in a new training brochure, "Where Do We Go From Here," recently published by the Allis-Chalmers Mfg. Co. This booklet, No. E6085-A, is available by request from Allis-Chalmers Mfg. Co. 569, Milwaukee 1, Wis.

DEPARTMENT OF LIBERAL EDUCATION in the House Organs in 15 Minutes a Day *** Packing Pistons the Cup Way, recent development by Warren Steam Pump Co. decreases power consumption and gives greater delivery; The Power Specialist, June-July, 1945 *** Industrial Use of Radiation Pyrometers; Open Hearth Furnace Pressure Control System; The Absolute Pressure Gage; and New Data on Instrument Technology and Applications; Instrumentation, July-August issue, 1945 *** Science Contributes New Technique to Exterior Painting of Concrete, giving details of a preventive treatment for use before painting; Building Maintenance, July, 1945 *** Russian Turbines, illustrated article describing some of the problems in constructing them; Iron Men of Hendy, Volume 3, No. 5 *** Fifteen-Acre Refrigerator—World's Largest, describing in detail the great storage cave of the U. S. Army at Atchison, Kansas, formed from an abandoned mine *** Package Treatment for Small Sewage Flows, The Yeomans Guard, July-August, 1945 *** Control That Speed!—Part II, Allis-Chalmers Electrical Review, June, 1945.

THE Monalphabet for printing type, as a possibility of simplifying our alphabet to one symbol for each character, is discussed by Bradbury Thompson in Westvaco Inspirations for Printers No. 152. for example, instead of using a capital that has an entirely different appearance from the small or lower case letter, we might use instead a lower case letter with a line under it. But a page of that might look too spotty. so we might make the capital letter the same shape as the lower case but somewhat larger and bolder. an interesting idea and worth some study by engineers, especially in connection with lettering on drawings, where the general practice now is to use all capitals drawn with a lettering guide or typed on a special machine. but there is nothing harder in the world to read than a solid block of "all cap" lettering.

THE COUNTRY'S most comprehensive research experiment and demonstration center for attacking problems of good, low-cost housing is being planned by the University of Illinois. A four-block area in the university will contain the demonstration center, with blocks of test houses around it. Thus many related tests and experiments can be carried on simultaneously.

TELEVISION AND FM radio broadcasting from stratosphere airplanes cruising six miles in the air, as soon as permits and equipment can be obtained, has been announced by Westinghouse. The "Stratovision" system was originated by C. E. Nobles. Television and FM radio waves travel in a straight line and for all practical purposes stop at the horizon. The Stratovision system simply puts the antenna and transmitter in an airplane flying in lazy circles 30,000 ft above the earth, out of sight of human eyes. The shortwaves sent out from this airborne antenna would blanket the earth's surface like a great inverted cone, covering an area 422 mi across, or equal to about the combined area of the states of New York, Pennsylvania, and New Jersey.

PLANS ARE going ahead, announces Bituminous Coal Research, for the patent application on the recently-developed meter for measuring the flow of pulverized coal and air mixtures. Industrial installations of the meter will be made to determine the effect of various sizes of pipes. The meter will be particularly useful in controlling flow of pulverized coal in branch lines supplied from a single pulverizer.

IF THERE WON'T BE very many young engineering graduates available to industry for several years (see What Leaders Say page, August issue) what can industry do about it, if anything? Dean Holbrook of the University of Pittsburgh advances, in Mining and Metallurgy, these suggestions: 1, Companies to urge veterans to complete college courses, giving some assurance of subsequent employment by the company; 2, larger companies might establish in-company training for promising men; 3, urge the state—and co-operate with it—to provide public schools of the technical institute type.

SMA Consolidated Table on Load Carrying Capacities, Minimum Furnace Dimensions, Draft and Chimneys for Typical Single Retort Underfeed Stokers, 2nd Edition—Revised May 1945 has just been issued by the Stoker Manufacturers Association. Single copies 5c; $2.50 per hundred.

MANY of the Merchant Marine's steam engineers with long records of sea duty during the war and fine backgrounds of experience in operating the up-to-date, high-pressure equipment installed on many of our ships, are now becoming available for civilian employment. If you can use one or more of this type of high-grade man in your own plant, or if you know any other engineers or plants that could employ them, pass the word along to the nearest employment offices, either the USES or the private employment services. It will cost you nothing. Here's a chance to begin to make up those manpower shortages.

THE LONGEST WAR of all is the one farmers have waged for centuries against insects. There are 80,000 different kinds of insects in the United States, responsible for agricultural losses of more than $2,000,000,000 a year. How chemistry helps the farmer battle the crop enemies and increases our food supply is told in detail in the Du Pont Magazine, Vol. 39, No. 3.

IF YOU GOT a few chuckles out of the "Kitchen of Tomorrow" in August Front Lines, don't laugh too hard for a while yet. Dr. John J. Grebe, head physicist of Dow Chemical Co. has designed a unit kitchen, made mostly of magnesium, plastics and glass, about the size of an automobile and costing about $1,000. Fitted into a house or added on, it contains, in a U-shaped assembly weighing about 3500 lb, all the equipment needed to cook, wash dishes, do all the laundry including drying, freeze and refrigerate food, provide bathroom facilities. A special stove supplies heat and there is an ingenious ventilating scheme. But what we want to know right now is: will it make MEAT?????

THE ALL-INCLUSIVE assembly of engineering equipment required to produce the heat, light, transportation and comfort we take so much for granted in our hotels, theaters, apartments and office buildings is interestingly described and illustrated in Lubrication, Vol. 31, No. 6.

IN THE JOB of completely rebuilding the dome of the Capitol of the Commonwealth of Pennsylvania at Harrisburg, the only means of communication with the hoist engineer from the various work levels was by a gong at ground level, operated by a rope 290 feet long. Finally an Executone master station was provided for the hoist engineer, and a substation was placed on the lift giving direct-voice, two-way communication over a span of several floors, increasing safety and efficiency. Might be a useful idea for use on some of the larger power plant construction jobs.

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THIS remarkable turbine oil developed exclusively by Shell, prevents sludge and rust in your turbines!

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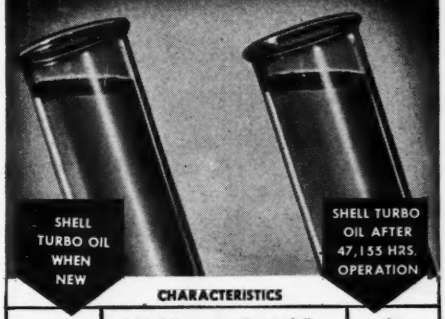

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156	S.U. Viscosity @ 100° F	162
1	Color, S.T.M.	2+
clear	Appearance	clear
none	Water	none
0.05	Acid Number	0.05
90	Steam Emulsion Number	165

**Performance record of Shell Turbo Oil in a 35,000 kw., turbo-generator running on steam at 925° F. and 1,290 lbs. per sq. in. after 47,155 hours of operation.*

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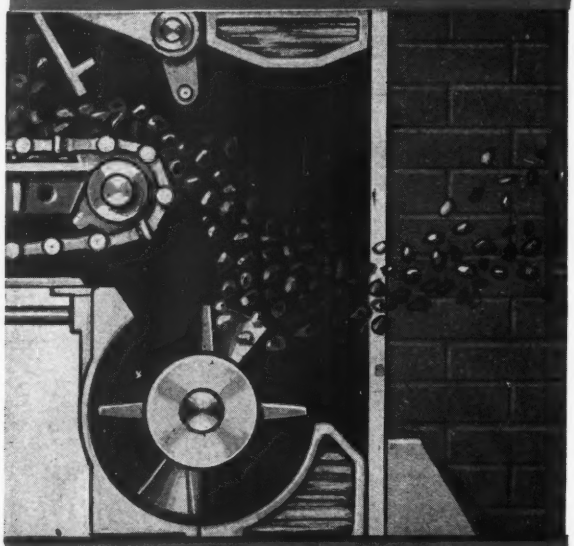

MORE STEAM at LOWER COST

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SPREADS PERFECT FUEL BED

Over-the-rotor feed covers the entire grate area with a "Perfect" fuel bed and causes less wear on the rotor and housing. The uniquely designed and balanced Æ rotor spreads fuel perfectly, the fines burning in suspension and the heavier particles dropping to the grate for thorough combustion. This rotor is an exclusive feature not found in any other stoker.

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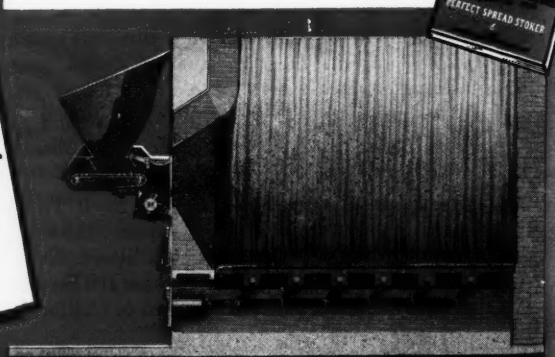

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That's why we believe you will want to know about the *improved* Taylor Stoker. It is not an untried, untested stoker, but one with a solid 39-year background of highly efficient service all over the world. Now, sweeping improvements have been made that rank it as a stand-out stoker for dependable, low cost steam generation . . . based on *today's* requirements . . . and built to *tomorrow's* needs.

You'll get a great deal of valuable information from the new Type "R" Taylor Stoker booklet, which details every improved feature and its advantages to *you*. Write for it *today*.

IF YOUR Steam Requirements Call for 20,000 to 500,000 lbs. per hour—

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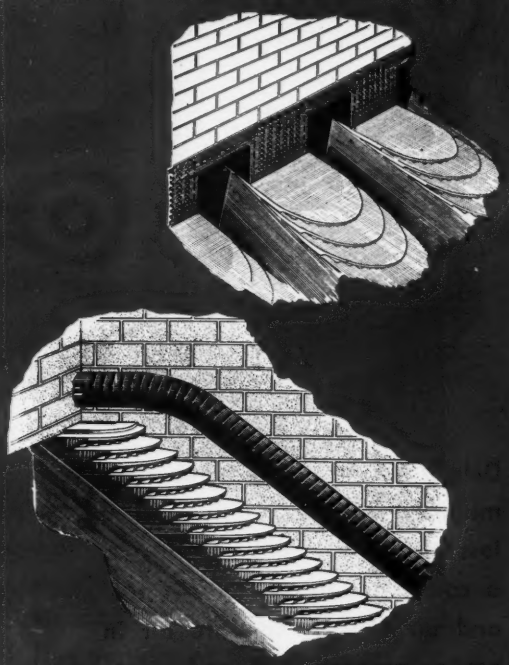
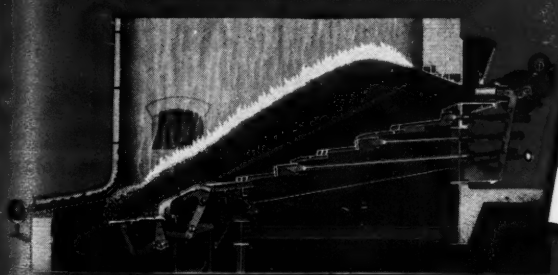
ANOTHER IMPROVEMENT IN THE TYPE "R" TAYLOR STOKER



AIR COOLING REDUCES SLAG FORMATION

Front Wall Air Boxes, Side Wall Air Nozzles and Half Tuyeres of the Taylor Stoker discharge continuous, uniform air screens that reduce slag and clinker formation on furnace walls. This increases operating efficiency and economy.

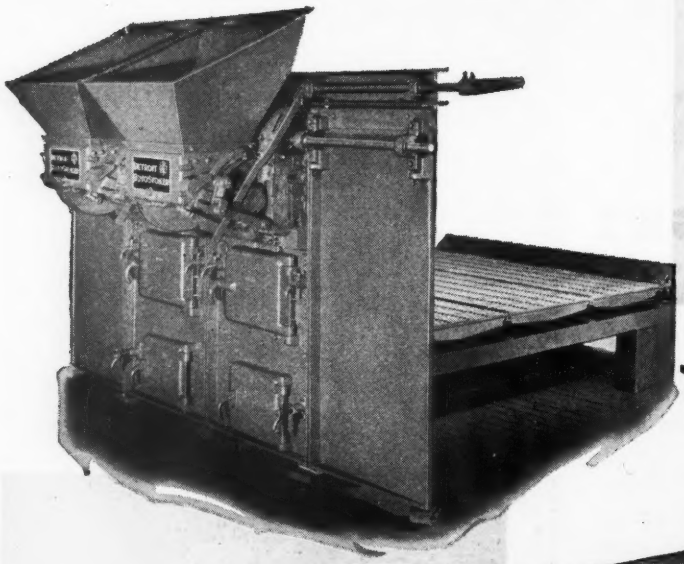


Æ TAYLOR STOKERS

AIR-COOLED & WATER-COOLED

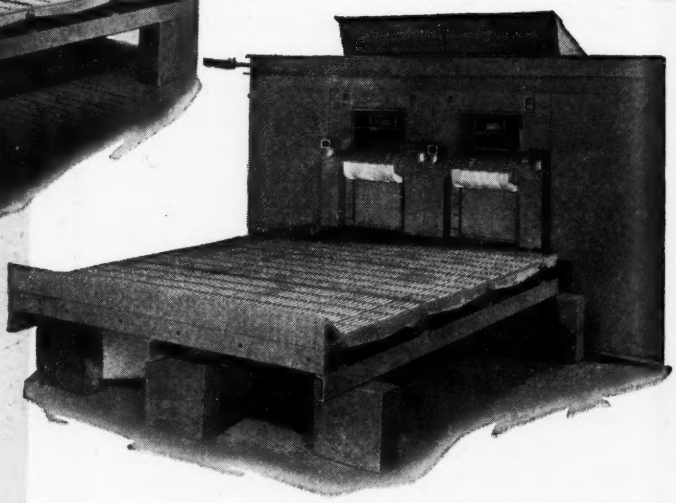
AMERICAN ENGINEERING COMPANY

PHILADELPHIA 25, PENNSYLVANIA



DETROIT ROTOSTOKER

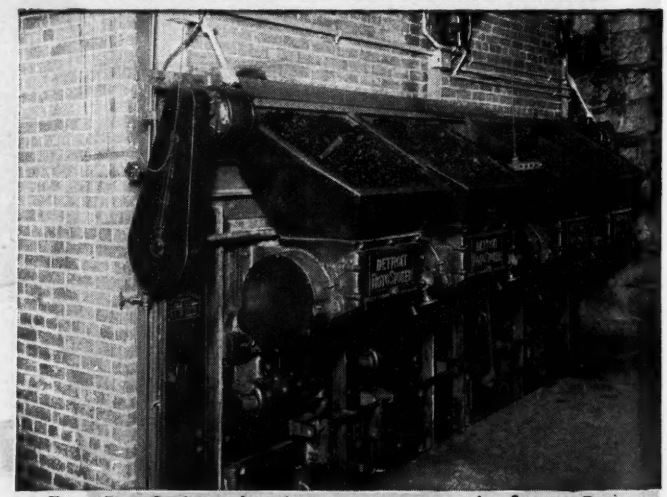
Handles Widely Fluctuating Loads



Detroit RotoStoker ready for inspection and shipment. All Detroit Stokers are assembled at the Works.

Detroit RotoStoker operates automatically with practically no time loss between a change in load and a corresponding change in fuel and air supply. Overfire air in proper proportion to undergrate air is introduced. Furnace turbulence takes place with a thorough mixing of the products of combustion that produces high carbon dioxide (CO_2) and correspondingly high efficiency at all ratings.

OVERTHROW ROTORS produce uniform fuel distribution. Fuel bed on the grates is comparatively thin and is penetrated by numerous air streams that cool the ash between the grates and the fire, to protect the stoker ironwork.

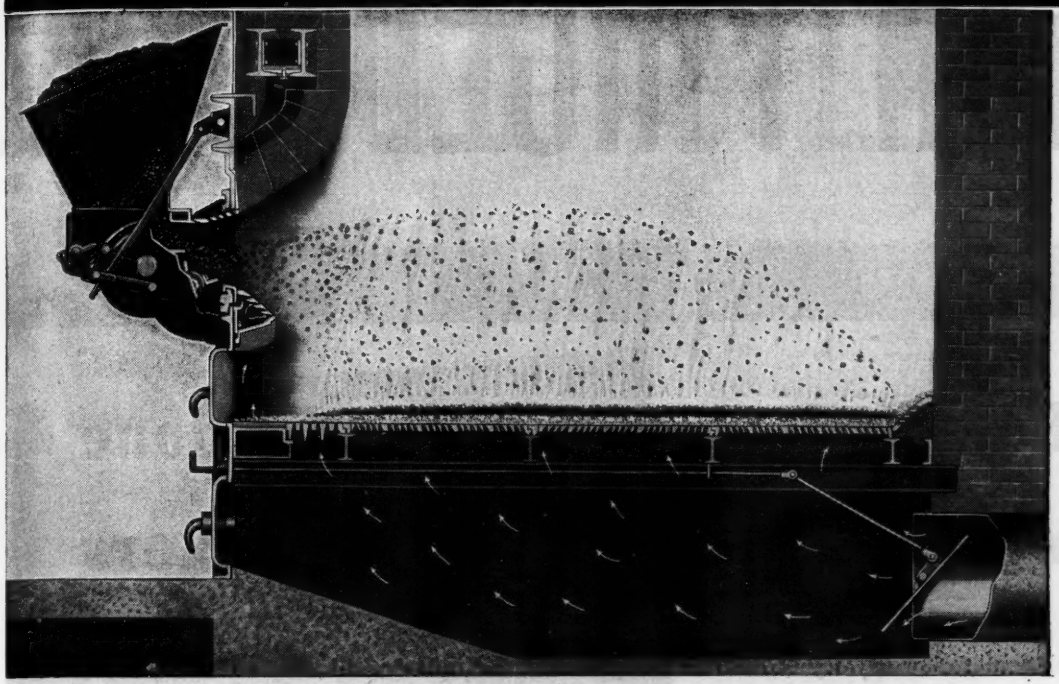


Two RotoStokers (stationary grate type) of two Rotors each with 180 horsepower boilers.

DETROIT STOKER COMPANY

Fifth Floor, General Motors Building, Detroit, Michigan • Works at Monroe, Michigan
District Offices in Principal Cities • Built in Canada at London, Ontario

DETROIT ROTOSTOKERS—BURN A WIDE RANGE OF FUEL

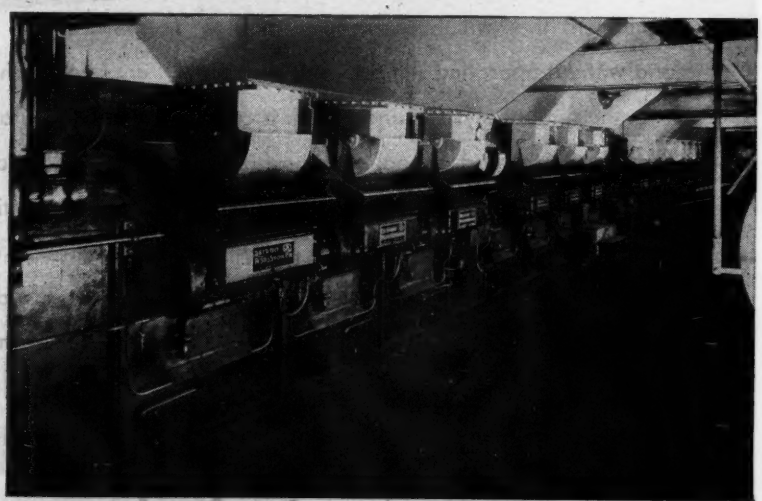


DETROIT ROTOSTOKER (Stationary Grate Type). Fine particles of fuel are burned in suspension and the coarse coal on the grates. OVERTHROW ROTORS produce uniform fuel distribution with a thin fuel bed.

Detroit RotoStokers successfully burn a wide range of fuel without special fuel preparation. Responsive to changes in load, under automatic control, they maintain uniform steam pressure. Compact in design. Heavily built for years of continual hard service. Popular among Engineers and easy to operate. Hundreds installed in all parts of the United States and Canada.

Showing four of six Roto-Stokers having three Rotors each, total eighteen Rotors, for which three contracts were received. Operated by a nationally known Shipbuilding Company.

The number and width of Rotors of each RotoStoker is varied to suit the boiler furnace width and capacity desired.



DETROIT STOKER COMPANY

Fifth Floor, General Motors Building, Detroit, Michigan • Works at Monroe, Michigan
District Offices in Principal Cities • Built in Canada at London, Ontario

HIGH PRICED COAL

Paradoxical—but it can be done with C-E Spreader Stokers

All coal is relatively high priced these days and much of it — that which is more easily available — is poor in quality. Paradoxically enough, it is possible to produce low-cost steam with these relatively high-priced, poorer-grade coals. It all hinges on having equipment that will burn them efficiently, and without operating difficulties.

In the final analysis, management is concerned with the cost of coal only insofar as it affects the cost of steam. In general, low steam costs are achieved chiefly through the use of proper fuel burning and steam generating equipment, intelligently operated.

Many plants, all over this country, have found the answer to lowered steam costs by installing C-E Spreader Stokers. This versatile stoker gives an excellent account of itself with almost any grade of coal, thus permitting the plants where it is installed a free choice in the matter of coal selection and enabling such plants to take advantage of any price changes in the coal market.

Why not make your plant independent of the uncertainties of coal price and production—present and future—by installing the service-proved C-E Spreader Stoker? It is a long step in the direction of *low steam cost*.

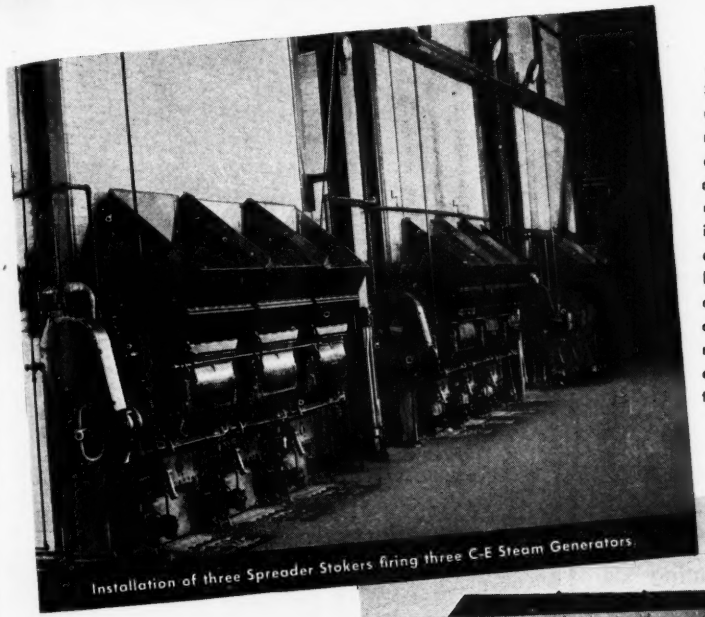
A-910

C-E

COMBUSTION

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

LOW COST STEAM

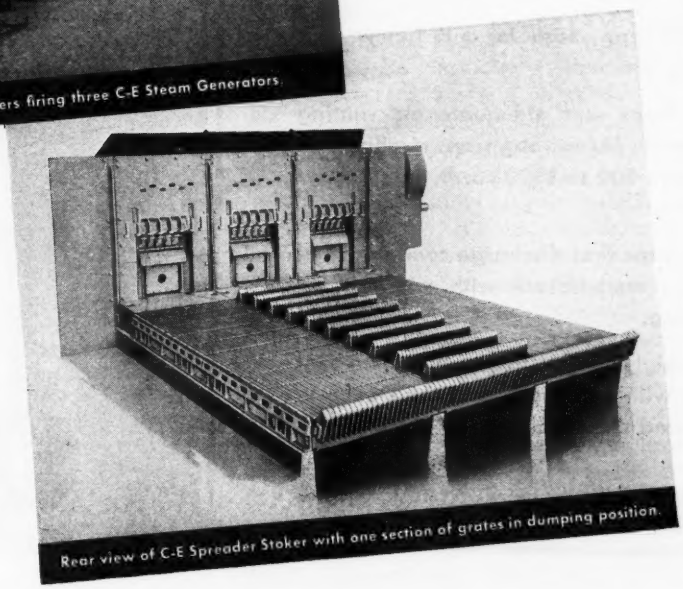


Installation of three Spreader Stokers firing three C-E Steam Generators.

Approximate application range of C-E Spreader Stoker — 150 boiler hp to largest units suitable for stoker firing. Simple, rugged construction. Hopper, feeding and distributing mechanism, variable-speed drive and motor are contained in a compact unit. Rotating spreader blades feed coal into furnace in crisscrossing streams which assure uniform distribution. Fines are burned in suspension and the rest of the coal is burned on a grate — stationary or dumping type. Grate surface is zoned for regulating air admission and to facilitate cleaning. Adapted to limited space conditions. Easy operation. Low maintenance.

THE SPREADER STOKER PAYS FOR ITSELF OVER AND OVER

In an average installation the cost of coal used in a year exceeds many times the initial cost of a C-E Spreader Stoker. Moreover, its first cost is soon absorbed by its saving in coal cost — an economy cycle repeated throughout its many useful years.



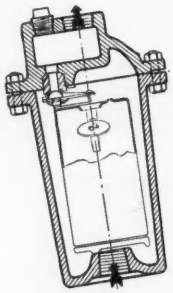
Rear view of C-E Spreader Stoker with one section of grates in dumping position.

ENGINEERING

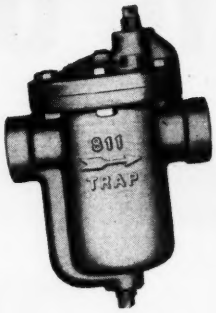
200 MADISON AVENUE, NEW YORK 16, N. Y.

HOW TO TRAP A LOW PRESSURE HEATING

Armstrong bottom-inlet, top-outlet style inverted bucket trap.



Cross-section of Armstrong Trap. Note simplicity of design.



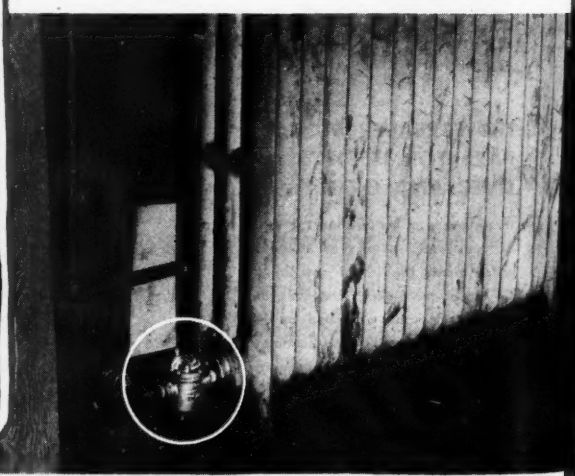
Side-inlet, side-outlet style. The cap carries the works; the body stays in the line during inspection or repair.

. . . for and greater

Trapping Tips for Heating Systems*

- Use one trap for each unit.
- Install trap close to and below unit being drained.
- Use traps with adequate air venting capacity. (Armstrong traps available to remove 500 to 1500 cu. ft. free air per hour.)
- Use traps that discharge condensate at steam temperature with no wait for cooling.
- Use high quality traps—any extra first cost will be repaid over and over in reduced maintenance.

Ask for Armstrong CATALOG H—36 pages of tables, data, diagrams on trap selection, installation and maintenance.



ARMSTRONG INVERTED BUCKET STEAM TRAP

ARMSTRONG

Over a Million in Use . . .

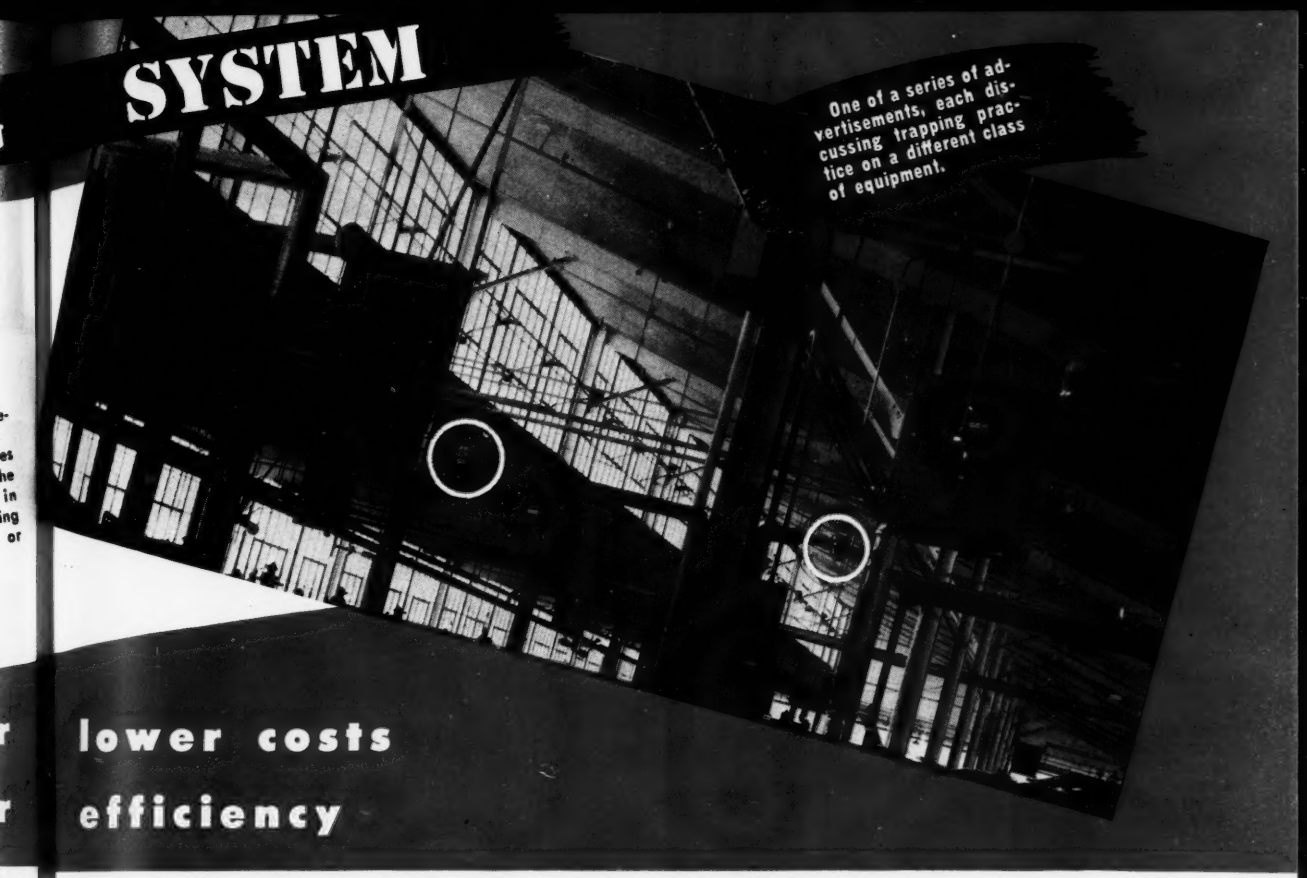

SYSTEM
One of a series of advertisements, each discussing trapping practice on a different class of equipment.
lower costs
efficiency

Photo Supply Company Reduces Trap Maintenance 50%; Academy Heats Up Buildings 50% Faster; High School Reduces Coal Consumption 5 Tons Per Day.

Many trap users have found by actual experience that their maintenance costs for so-called low pressure traps on easy heating service were GREATER than for Armstrong Traps on heavy duty high pressure service. Furthermore, records have shown that the extra maintenance costs more than made up for any saving in first cost. It is not surprising, therefore, that these buyers have standardized on Armstrong Traps for all services, with these results:

1. Maintenance costs are sharply cut.
2. Steam leaks have been eliminated.
3. Better performance is secured from steam-heated units.
4. Net trap cost is lower on a yearly basis.

Here are some of the reports:

Defender Photo Supply Co., Rochester, N. Y., put 300 Armstrong Traps on unit heaters, fin coils, etc., and found trap maintenance about half of what it was before.

New York Military Academy heats up buildings 50% faster in the morning since Armstrong Traps were installed.

Springfield, Ohio, high school reduced coal consumption from 9 tons down to 4 tons daily and eliminated need for one boiler—with 30 Armstrongs.

Northwestern Store Equipment Corp., Milwaukee, Wis., reduced coal consumption from 460 tons to 290 tons annually and was able to reduce steam pressure from 10 lbs. to 3 lbs.

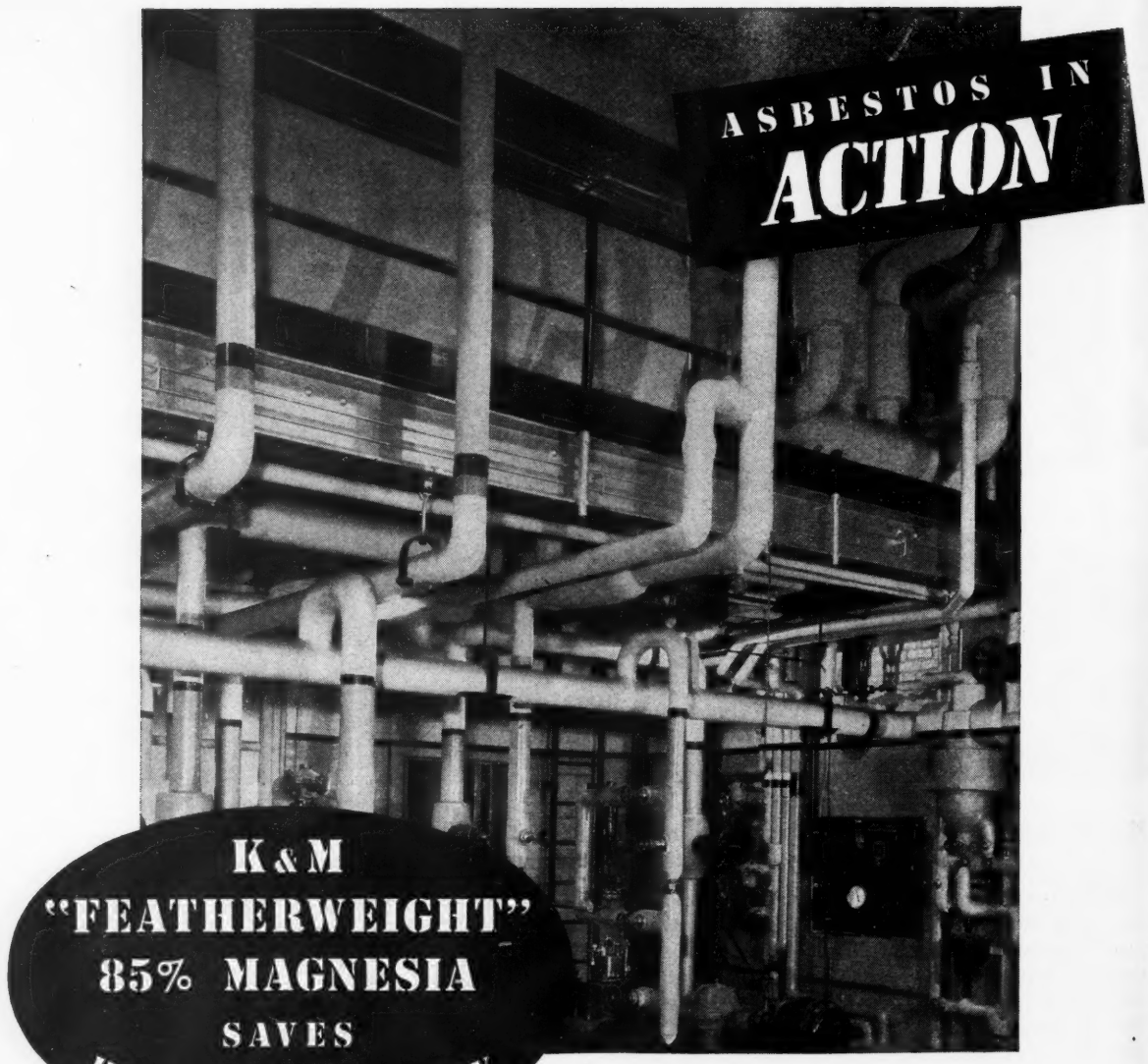
Brown Shoe Company, St. Louis, installed 180 Armstrong Traps on coils, unit heaters and header drips after surveying maintenance costs.

Atlanta building reports: "Not one cent for trap maintenance in 10 years."

It pays to buy quality. Armstrong traps don't leak steam; they have adequate automatic air handling capacity; they'll last a long time because of chrome steel valve and seat (hardened, ground and lapped) and stainless steel bucket and valve lever assembly. Nothing to stick, clog or collapse. For any pressure, any vacuum. Sold through leading distributors everywhere. Write for a survey of your plant today. ARMSTRONG MACHINE WORKS, 810 Maple Street, Three Rivers, Michigan.

Inverted Bucket **STEAM TRAPS**

For Power . . . Process . . . Heating



TESTED BY TIME . . . PROVED BY PERFORMANCE

The extensive network of steam and hot water lines in this large mid-western power plant are insulated with K&M "Featherweight" 85% Magnesia. This choice was not the result of guesswork, but was based on sound engineering calculations made after a thorough analysis of previous pipe line heat losses.

K&M "Featherweight" 85% Magnesia Pipe Insulation offers lasting effectiveness, durability, dependability and low maintenance costs. It saves heat . . . fuel . . . money. For temperatures up to 600° F., no other material can offer such enduring economy.

K&M "Featherweight" 85% Magnesia Pipe Insulation combines the high insulating qualities of basic Carbonate of Magnesia with strong Asbestos Fibres. Although extremely light in weight, it delivers maximum efficiency. For 65 years, plant operating men have known "Featherweight" as a symbol of quality.

KEASBEY & MATTISON

COMPANY • AMBLER • PENNSYLVANIA

New Gargoyle D.T.E. Oil 797 gives you all these

TURBINE OIL EXTRAS!

EXTRA RESISTANCE TO OXIDATION

In process of development for more than ten years, this great new Gargoyle turbine oil sets a new high standard for resistance to the formation of oxidation deposits. Under severe conditions of oxidation it stands up far longer than any other turbine oil. This means valves and sensitive governing devices free of deposits.

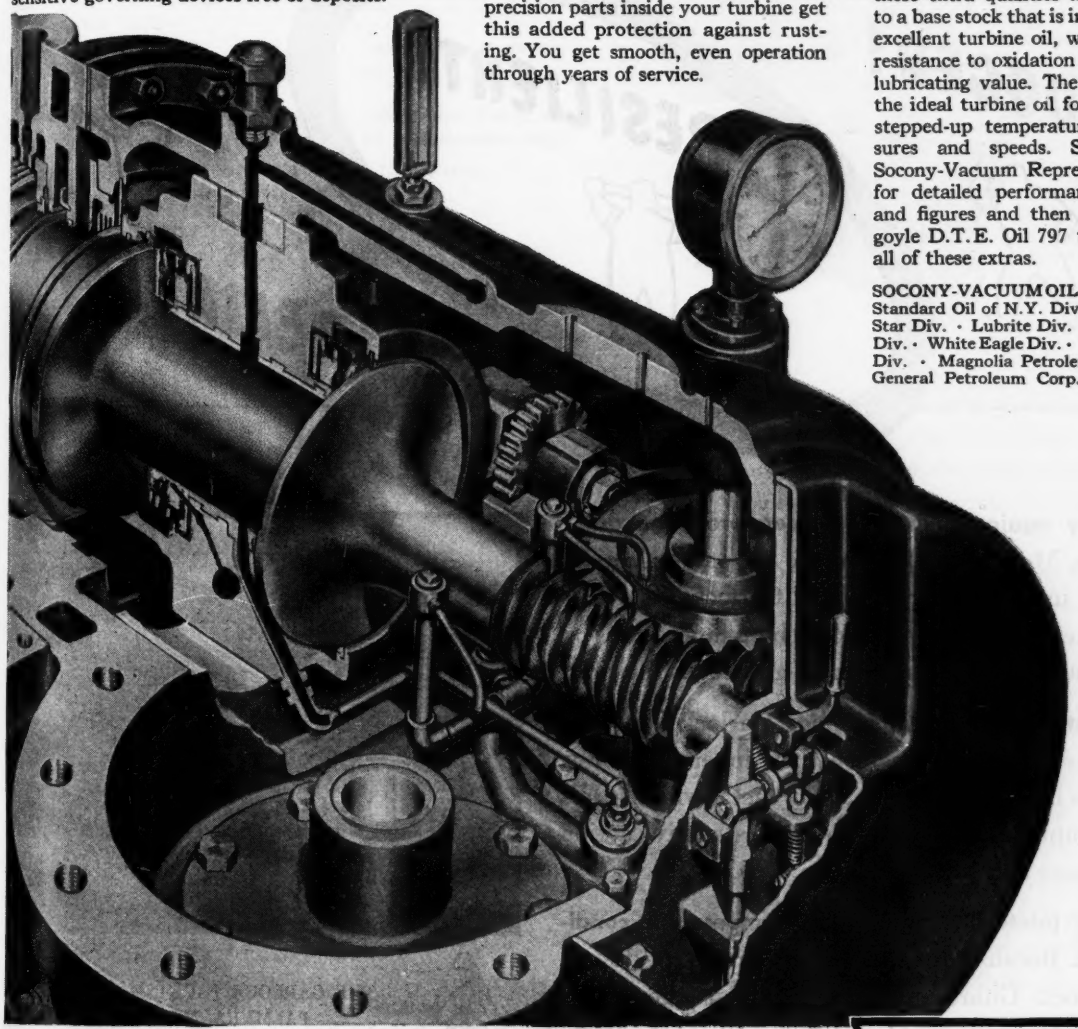
EXTRA PROTECTION AGAINST RUSTING

Already proved in turbines of all sizes, new Gargoyle D.T.E. Oil 797, provides, when required, the extra resistance to rusting for long, trouble-free turbine operation. Your bearings, gears, all the precision parts inside your turbine get this added protection against rusting. You get smooth, even operation through years of service.

EXTRA SAFETY IN THE BASE STOCK

In Gargoyle D.T.E. Oil 797, these extra qualities are added to a base stock that is in itself an excellent turbine oil, with great resistance to oxidation and high lubricating value. The result is the ideal turbine oil for today's stepped-up temperatures, pressures and speeds. See your Socony-Vacuum Representative for detailed performance facts and figures and then get Gargoyle D.T.E. Oil 797 to obtain all of these extras.

SOCONY-VACUUM OIL CO., INC.
Standard Oil of N.Y. Div. • White Star Div. • Lubrite Div. • Chicago Div. • White Eagle Div. • Wadhams Div. • Magnolia Petroleum Co. • General Petroleum Corp. of Calif.



SOCONY-VACUUM'S 5 Steps to Lower Production Costs:

1. Lubrication Study of Your Entire Plant
2. Lubrication Schedules and Controls
3. Lubricant Storage and Handling System
4. Skilled Engineering Counsel
5. Progress Reports of Benefits Secured

GARGOYLE Lubricants

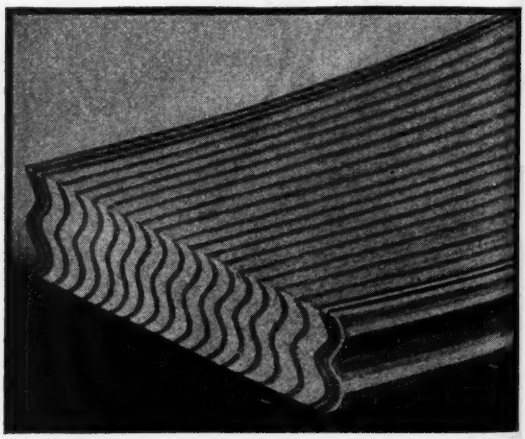
TUNE IN "INFORMATION PLEASE"—MONDAY EVENINGS, 9:30 E.W.T.—NBC

THE GARLOCK GUARDIAN GASKET

Safety against extreme temperatures and pressures. Metal and asbestos are the only materials used in the construction of Garlock Guardian Gaskets. They are unaffected by temperatures or pressures encountered in any gasket installation.

Resistance to gases and liquids. Garlock Guardian Gaskets are protected on their inner and outer edges by a double thickness of metal which forms an impregnable barrier to the destructive action of gases and liquids.

Tight joints under changing temperature conditions. Because of their unique structural design, Garlock Guardian Gaskets adjust themselves instantly and repeatedly to expansion and contraction due to temperature changes or vibration.



THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK
In Canada: The Garlock Packing Company of Canada Ltd., Montreal, Que.

GARLOCK

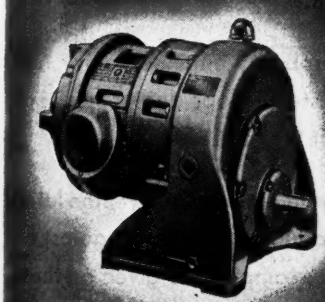
Nine good reasons for

Modernizing with Westinghouse Gearmotors

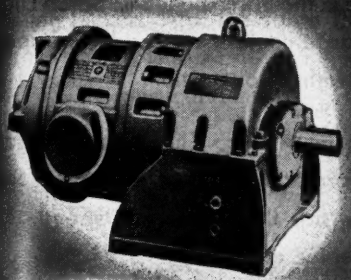
on drives from 1 to 75 hp

1. FEWER PARTS TO WEAR
2. BPT "TOUGH-HARD" GEARS AND PINIONS
3. USE ALL WESTINGHOUSE MOTOR TYPES
4. HIGH EFFICIENCY
5. POSITIVE LUBRICATION
6. EASY ACCESSIBILITY
7. IMPROVED FOUNDATION STABILITY
8. MOTOR AND GEARS BUILT BY ONE MANUFACTURER
9. DESIGNED AND APPLIED TO A.G.M.A. STANDARDS

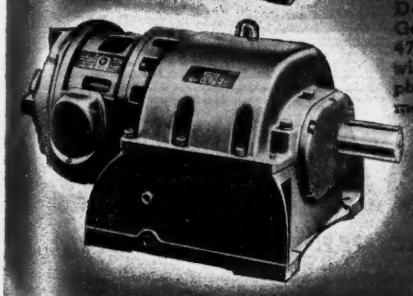
There is a Westinghouse speed reduction unit for most applications



TYPE A GEARMOTOR—Single-reduction unit. Gear ratios 1.22, 1.50, 1.84, 2.24, 2.73, 3.37, 4.17, 5.00, 6.25. Available with single-phase, polyphase, and direct current motors.



TYPE C GEARMOTOR—Double-reduction unit. Gear ratios: 7.61, 9.21, 11.3, 14.0, 17.5, 20.8, 25.7. Available with single-phase, polyphase, and direct current motors.



TYPE E GEARMOTOR—Double-reduction unit. Gear ratios: 31.2, 38.9, 47.3, 52.7, 58.3. Available with single-phase, polyphase, and direct current motors.

In the last few years, machine drives have taken a terrific peak-load punishment. So it's natural that reconversion will require many replacements with modern, economical drives.

When drives require speed reduction... and four out of five do...use a gearmotor. Specifying gearmotors simplifies ordering and delivery...saves installation expense because the complete drive is in one "package".

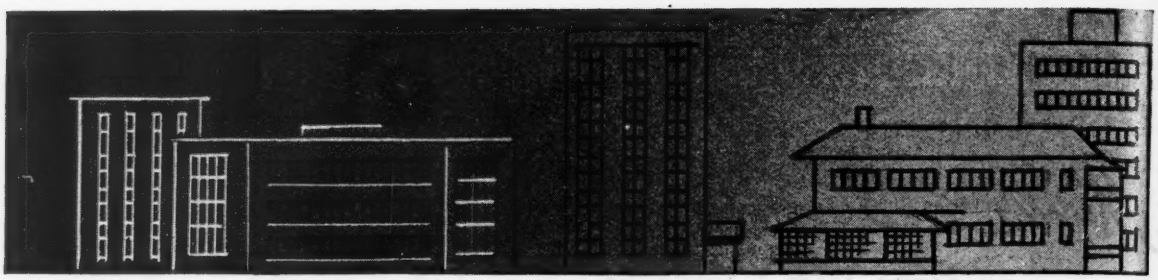
Westinghouse offers a complete line of gearmotors for speed-reduction drives up to 75 hp, and a complete line of similar speed reducing units for drives up to 1000 hp. Call your Westinghouse Office for information, or write Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

J-07229

Westinghouse

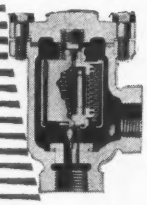
PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

Gearmotors

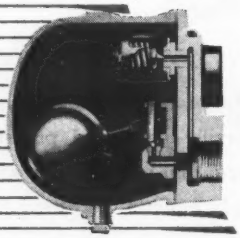


TOMORROW'S

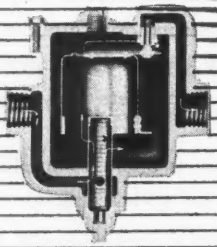
BETTER . . . . .



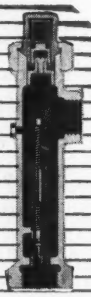
THERMOSTATIC STEAM TRAP



FLOAT-THERMOSTATIC STEAM TRAP



BUCKET STEAM TRAP



BZ TRAP-CONTROL

If you are responsible for heating performance and heating costs in a theatre, commercial or industrial building—the chances are that you can increase the over-all efficiency 10 to 25%.

If the system was installed more than ten years ago—Sarco's technical developments and improvements alone would justify modernization.

If recently built—it was probably engineered for rush construction and the right steam traps and control may not have been available at the time.

In any event, it will pay any engineer to go over the latest developments in Sarco Products as a check against his heating operations. A few examples are given on these pages. Complete data in the Sarco Bulletins. Sarco Engineers located in all large centers are ready to inspect your heating system, without obligation.

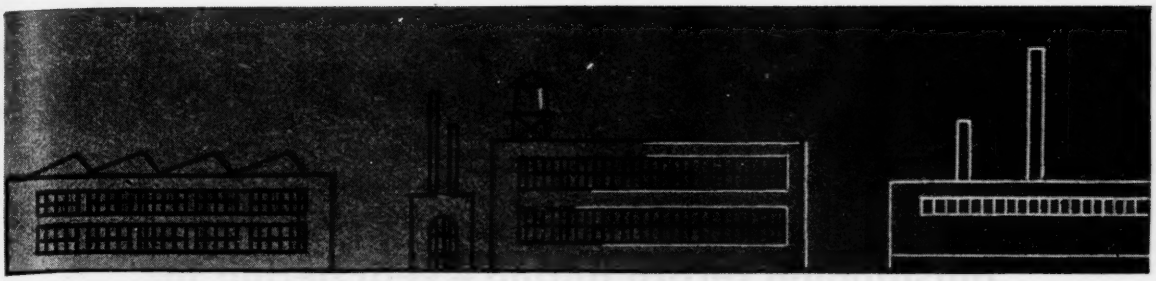
FOR INSTANCE, the new Sarco Thermostatic Steam Trap has double its former capacity to discharge condensate or air. It now has the power and speed of a bucket trap—and greater efficiency.

FOUR STARS ON OUR E PENNANT TESTIFY TO SARCO PERFORMANCE IN THE WAR EFFORT

Represented in Principal Cities

SARCO

SARCO COMPANY, INC., 475 FIFTH AVE., NEW YORK 17, N.Y.



HEATING • • •

AND AT LOWER COST

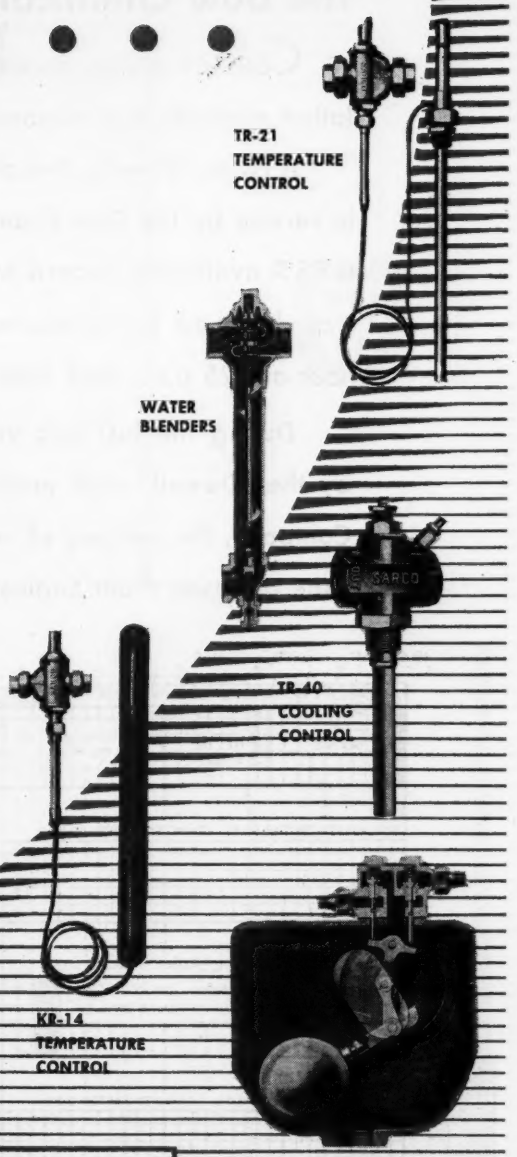
SARCO FLOAT-THERMOSTATIC and Bucket Traps have been still further perfected and ranges extended. A variation of the float trap is now used as a liquid level control.

THE SARCO 87, a low cost trap-control is now made in many forms—for tank control and out-door heater lines and tanks (it can't freeze).

THE SARCO TR-21 temperature control for hot water heating and process work is complemented by a series of rigid stem controls for heaters, tanks and scores of new applications. KR-14, its companion control for air and gases, has been improved.

SARCO WATER BLENDERS, now made in three types, serve all purposes from individual showers to engine cooling jackets. And the Sarco TR-40 cooling control is saving up to 50% of the water used on compressors, degreasers, and condensers.

Other developments too numerous to mention are illustrated in the Sarco Hook-Up Book and the Sarco Bulletins. Ask the nearest Sarco representative to make up a set applying particularly to your conditions.



Saves Steam

• Sarco Canada, Ltd., 85 Richmond St., W., Toronto 1, Ont.

121

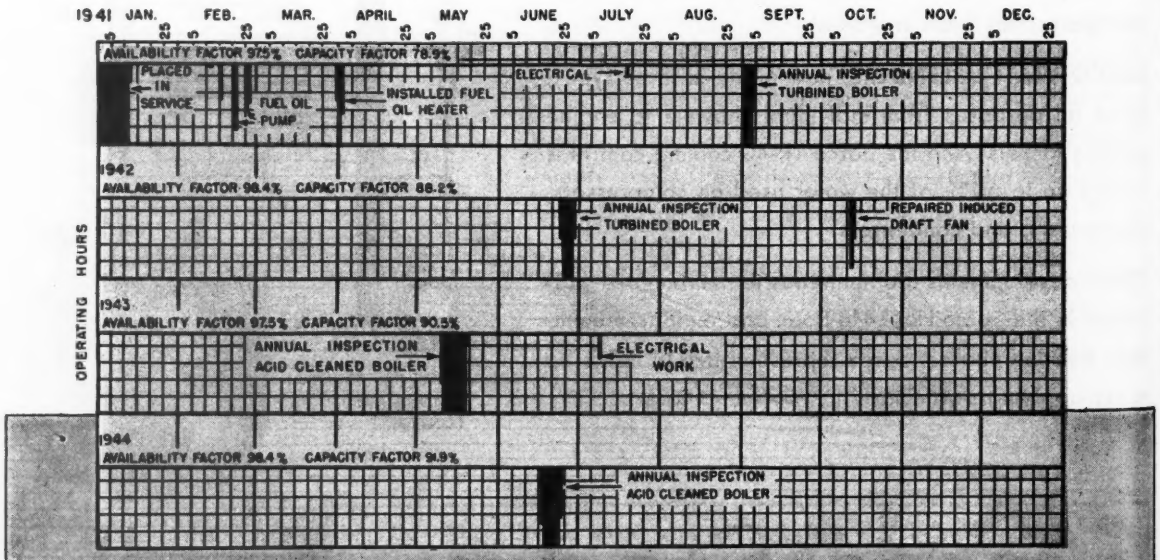
Availability Record

Foster Wheeler steam generator establishes outstanding record during 4 year period for The Dow Chemical Company.

CORRECT design, accurate shop fabrication and proper installation methods are responsible for an outstanding performance.

A Foster Wheeler, two drum, "D"-type steam generator, placed in service by The Dow Chemical Company in 1941 has established a 98% availability record over a four year test period. This boiler was designed for a maximum load of 150,000 lb. of steam per hour at 425 p.s.i., and final steam temperature of 735 deg. F.

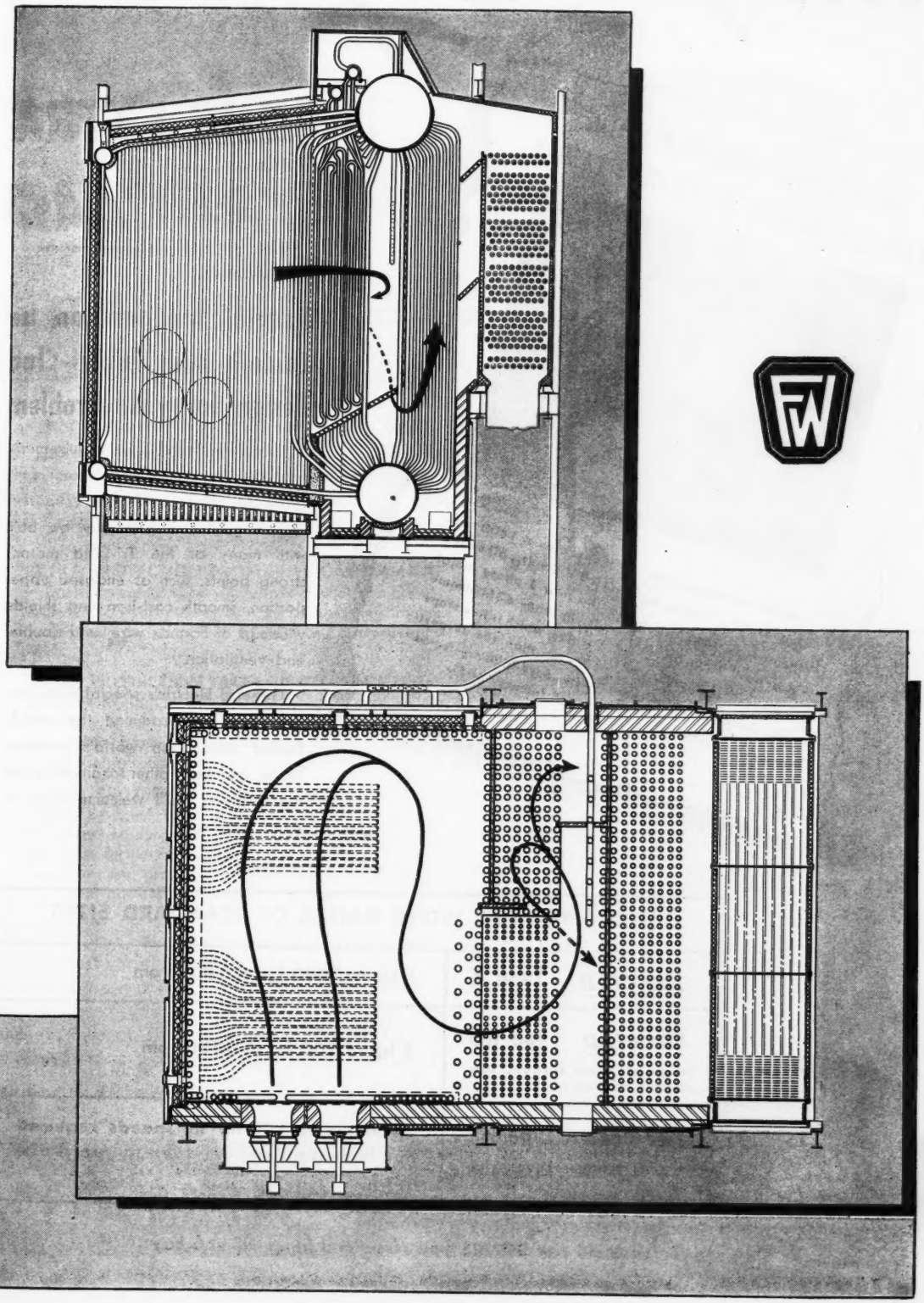
During the last two years the boiler was cleaned internally by the "Dowell" acid method developed by The Dow Chemical Company, the success of which is given in an article in the July issue of *Power Plant Engineering*.


1941 JAN. FEB. MAR. APRIL MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC.
AVAILABILITY FACTOR 97.5% CAPACITY FACTOR 78.9%
PLACED IN SERVICE
FUEL OIL PUMP
INSTALLED FUEL OIL HEATER
ELECTRICAL
ANNUAL INSPECTION TURBINED BOILER
1942
AVAILABILITY FACTOR 98.4% CAPACITY FACTOR 88.2%
ANNUAL INSPECTION TURBINED BOILER
REPAIRED INDUCED DRAFT FAN
1943
AVAILABILITY FACTOR 97.5% CAPACITY FACTOR 90.5%
ANNUAL INSPECTION ACID CLEANED BOILER
ELECTRICAL WORK
1944
AVAILABILITY FACTOR 98.4% CAPACITY FACTOR 91.9%
ANNUAL INSPECTION ACID CLEANED BOILER
OPERATING HOURS

FOSTER WHEELER CORPORATION • 165 BROADWAY, NEW YORK 6, N. Y.

FOSTER WHEELER

98% over Four Year Period



now your Big drives

NEW 2000-hp INDUCTION MOTOR LARGEST MEMBER OF TRI-CLAD FAMILY

Dwarfing the original Tri-Clad motor (resting on the conduit box) in size, this new 2000-hp "big brother" embodies all the same protective construction features.

It operates at 1800 rpm, on 2300 volts, 60 cycles. This new 3-phase motor is in the 6360-frame series, which is five steps larger than the largest standard industry frame size (namely 505).

*THE EXTRA TRI/CLAD

REG. U.S. PAT. OFF.

Special motors can be custom built in Tri-Clad design for *your* problem

Your exceptional drive requirements may call for an induction motor specially designed to the job. Whatever its rating, it can generally be built with many of the Tri-Clad motor's strong points, such as enclosed upper portion, smooth cast-iron end shields, windings of Formex wire, and double-end ventilation.

General Electric's special motor engineering has produced the world's fastest motor, the world's strongest motor, and many other tradition-breaking designs. We'll welcome your unusual problems.

HERE'S TODAY'S WIDER RANGE OF STANDARD SIZES	
TRI/CLAD **Type K**	**1 hp to 2000 hp at 1800 rpm**
TRI/CLAD **Type KG** (High starting torque, low starting current)	**5 hp to 200 hp at 1800 rpm**
TRI/CLAD **Type KR** (High starting torque, high slip)	**Available to 100 hp in speeds required for high-slip flywheel drive (punch press, etc.)**

TRI/CLAD MOTORS

Buy all the BONDS you can—*and keep all you buy*

can have it, *too

PROTECTION OF CONSTRUCTION

G-E STANDARD Tri-Clad Induction Motors Now Available to 2000 hp

For that important *big* drive (up to 2000 hp, 1800 rpm) you can now get a G-E standard Tri-Clad induction motor. All the protective features that have proved so valuable to service continuity and long life in the more widely used sizes are included:

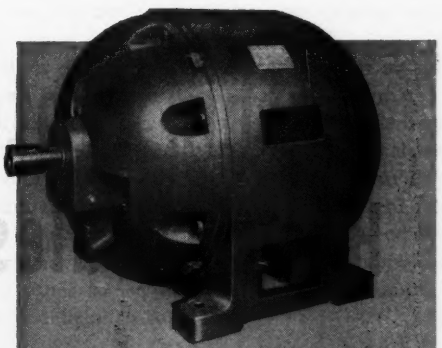
EXTRA PROTECTION FROM PHYSICAL DAMAGE—Cast-iron construction with upper portion completely enclosed to keep out falling objects, dripping liquids. Streamline, cast-iron end shields. Corrosion-resisting finish.

EXTRA PROTECTION FROM ELECTRICAL BREAKDOWN—Windings of Formex* wire are solidly bonded with synthetic resins strongly resistant to heat, oil, and moisture. Formex wire insulation stands up strongly under abrasion or "heat-shock."

EXTRA PROTECTION FROM OPERATING WEAR AND TEAR—Available with either sleeve or ball bearings—in dust-tight housings. Sleeve-bearing design is a further refinement of well-proved Tri-Clad motor bearing proportions, efficiently lubricated, with "air seal" to insure oil tightness of the housing.

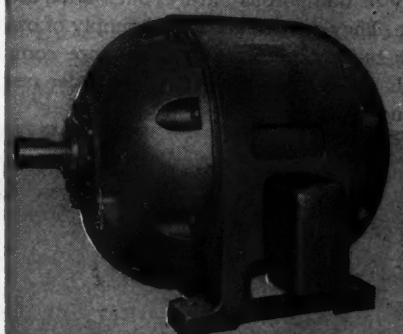
The Tri-Clad, in its wide range of types and sizes, is G.E.'s most widely used (integral-hp) motor. Chances are that there's a Tri-Clad to meet your requirements "on the nose." For information on General Electric's complete line of Tri-Clad motors, ask for GEA-3580. *General Electric Company, Schenectady 5, N. Y.*

*Trade-mark reg. U.S. Pat. Off.



Typical large-size sleeve-bearing Tri-Clad polyphase motor, now standard up to 2000 horsepower.

Modified cast-iron frame construction used for certain large sizes of the extended Tri-Clad motor line.



Separable housing construction used for large-size ball- or roller-bearing Tri-Clad motors. Roller bearings are standard at coupling end.

GENERAL ELECTRIC

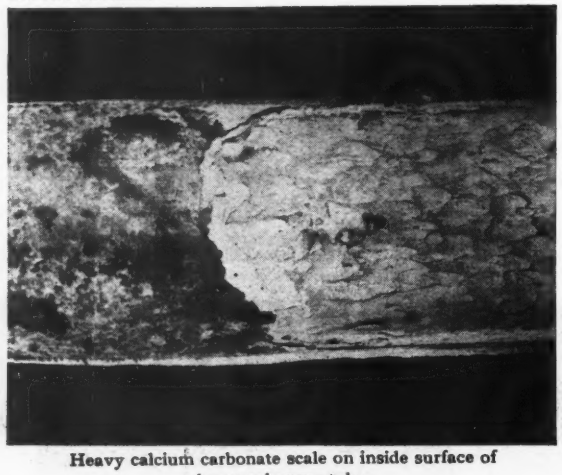
Scovill Tube News

Vol. 3 SCOVILL MANUFACTURING COMPANY, Waterbury 91, Conn. No. 3

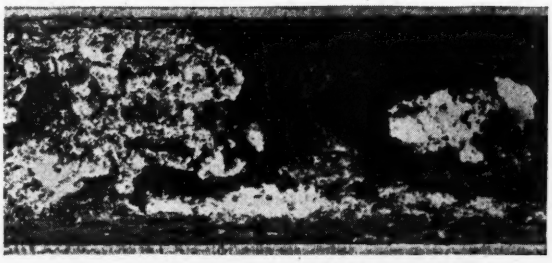
Thin Protective Films vs. Heavy Scales on Tube Surfaces

It is a well-established fact that the corrosion resistance of heat exchanger tubes bears a direct relationship to their ability to form and maintain protective films over their surfaces under any given set of service conditions. The protection afforded by films may vary considerably, depending upon the particular environment under which the tubes must serve. Under certain conditions, films offer full protection indefinitely and no visible corrosion of the metal results; in other cases, intermediate degrees of protection are obtained, while under extreme conditions, films may not form at all or once formed may undergo rapid and complete breakdown, resulting in relatively rapid destruction of the tube through corrosion.

Natural protective films which form over metal surfaces are characterized by their thinness, often only one or two molecules in thickness, and their continuity or non-porous nature. Such films are often invisible. They may be composed simply of oxides of the metals but more often films of more complex compounds may be equally protective under certain service conditions.



Heavy calcium carbonate scale on inside surface of heat exchanger tube.



Thick discontinuous sulphide scale on inside surface of heat exchanger tube removed from an oil refining unit.

In contrast to the protective value of thin films on metal surfaces, heavy or relatively thick deposits or scale which are allowed to build up on tube walls offer less satisfactory protection against corrosion and often accelerate corrosion to a marked degree. In addition to their deleterious effect on corrosion, heavy scaling of heat exchanger tubes materially reduces heat transfer with a resultant drop in efficiency of the unit.

The increasing thickness of deposits on tubes over a period of time may result chiefly from corrosion products formed as a result of attack of the metal by the medium in contact with the tube. Continued growth of this kind indicates that the metal under that particular environment has not been able to form a perfect protective coating to inhibit or prevent further attack. Very often, heavy scaling of tubes is not due to corrosion of the tube material but to chemical compounds, such as calcium carbonate and calcium sulphate, which are deposited or laid down by the circulating waters; under certain operating conditions and in contact with some types of circulating water, scaling of this kind may build up rapidly.

Heavy scaling of heat exchanger tubes may promote or accelerate corrosion in various ways. For example, such deposits are of a porous nature and therefore non-protective, and permit seepage of corrosive

media through the scale to the metal surface where various types of corrosive action can be set up. Heavy scales are also brittle and consequently are liable to crack or flake off, exposing areas of the tube wall to the action of the circulating media. One of the most serious consequences of heavy scale formation on tubes, however, is directly associated with a resulting increase in tube wall temperature, due to interference of the scale with efficient heat transfer through the tube wall. It is generally recognized that corrosion is accelerated with increasing temperature and a moderate temperature rise of 10°C. may actually double the corrosion rate. Under any service, therefore, it is important to maintain as low a tube wall temperature as conditions will allow.

As an illustration of possible severe corrosion resulting from heavy scaling, a case may be cited in which a heat exchanger is operating with scale-forming cooling water passing through the tubes and hydrocarbon vapors containing active sulphur compounds circulating around the outside of the tubes. During the initial period of operation, the water side of the tube would be relatively free from scale and the tube wall temperature would approach that of the cooling water; as operation proceeded and an insulating scale built up on the inside tube surface, the tube wall temperature would then approach that of the hydrocarbon vapors and corrosion at the vapor side by the active sulphur compounds would be very considerably accelerated. Dezincification of Muntz Metal, uninhibited Admiralty Metal and occasionally even Red Brass tubes has often been experienced beneath heavy deposits of scale, due primarily to the relatively high tube wall temperature caused by the insulating layer of scale.

Various preventative measures may be taken to minimize tube failures directly attributable to scale formations on the tube surfaces. Chemical treatment of cooling waters has been successful in many installations for the purpose of holding in solution scale-forming salts which would normally precipitate out on the metal surfaces. Water treatment may also aid in minimizing corrosion of the tube metal. Neutralization of vapors, gases, etc. by specific reagents has also been used to reduce corrosion and prevent the growth of deposits on tubes. When such treatments can be economically employed, they should be given careful consideration. Under conditions which will not permit of scale preventative measures, it is good practice to clean the tube surfaces periodically either mechanically or chemically or by a combined mechanical-chemical treatment. Any mechanical cleaning of tube surfaces requires reasonable care as well as the use of proper cleaning devices so that no scratching, scoring or other damage to the tubes results. Chemical cleaning methods should be of such a nature that no active corrosion of the tubes or other parts of the unit takes place; on the other hand, the chemical treatment must be drastic enough to dissolve the deposit of scale completely or loosen it sufficiently so that it can be entirely removed subsequently by a mechanical treatment. It is obvious that a chemical treatment which will only attack and dissolve part of the scale without affecting other scaled areas may be detrimental instead of beneficial to tube life.

SCOVILL OFFERS 3 SERVICES

Information which operators of condensers and heat exchangers can use to improve results is one of three types of service available from Scovill. From this *Service in Manuals* (of which "Scovill Tube News" provides a sample), our customers are given the benefit of our engineers' most recent thinking and the results of their studies.

Assistance is the second Scovill service. Through *Service in Men,* our engineers are available to you for specialized, individual consultation on problems relating to installation and maintenance of tubes.

And the third Scovill service is *Service in Metals* which makes available to you our complete laboratory facilities to help you determine the alloy best suited to your conditions.

Write for a free copy of our Condenser Tube Booklet, addressing Scovill Manufacturing Company, 17 Mill Street, Waterbury 91, Conn.

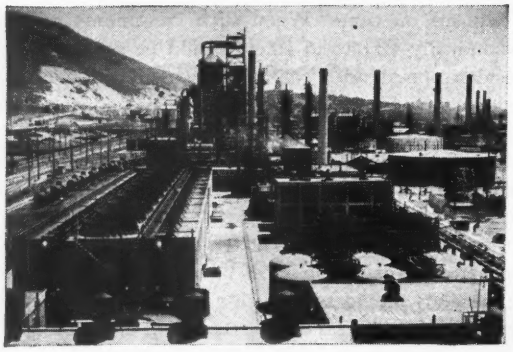
THIS IS NUMBER SIXTEEN in a Series of Scovill Advertisements to help you get longer life from condenser and heat exchanger tubes.

Scovill
MANUFACTURING COMPANY
WATERBURY 91, CONN.

SCOVILL CONDENSER TUBES

ONE PRODUCT... THREE SERVICES

Service in Manuals... Service in Metals... Service in Men

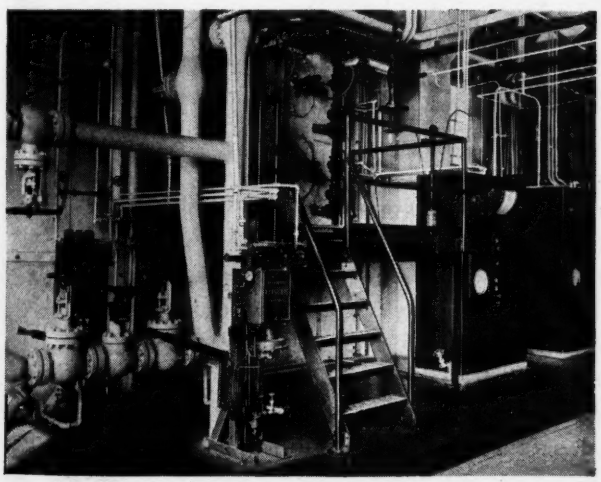


"K-RATION" STATION

Semi-outdoor installation of four B&W Integral-Furnace Boilers for Plant 2 at Utah Oil Refining Company, Salt Lake City. Fired with four B&W Steam-Mechanical Combination Oil and Refinery Gas Burners, each boiler generates 65,000 lb. steam per hour at 325 psi and 525 F. Postwar, the boilers will operate at 615 psi and 700 F. Only the firing aisle and boiler auxiliaries are indoors, as shown on the opposite page. Engineering and design by Sargent & Lundy, Chicago.

FOR FIGHTING PLANES SERVED BY B&W INTEGRAL-FURNACE BOILERS

Not so long ago, the possibility of enemy shells falling on American soil . . . of west-coast refineries being seriously menaced . . . were vital military considerations. So vital, in fact, that steps were taken to provide inland emergency sources of high-octane gasoline. Construction was therefore rushed on additional facilities for this purpose at the Utah Oil Refining Company plant in Salt Lake City.



In this "K-Ration" station—a plant built expressly to insure ample aviation fuel reserves—steam generators of highest dependability were especially imperative.

Four B&W Integral-Furnace Boilers were selected for this new Utah unit. Semi-outdoor installation of the boilers not only speeded completion of the power plant but saved 50 per cent in construction costs. Each boiler produces 65,000 lb. steam per hour at 325 psi and 525 F. total temperature at superheater outlet.

In other refineries, too, as well as in steel mills, chemical plants, ordnance plants, aircraft factories . . . wherever American industries were busy producing materials for war, B&W Integral-Furnace Boilers supplied steam with utmost dependability and efficiency. Thoroughly tried and proved in pre-war services, these boilers have further demonstrated their high availability for service and consistent reliability in tough war-time assignments.

From this additional proving under unprecedented service conditions will come still better B&W Integral-Furnace Boilers for peacetime industry.

For additional information on B&W Integral-Furnace Boilers, send for Bulletin G-17-A.

B&W

Water-Tube Boilers, for Stationary Power Plants, for Marine Service . . . Water-Cooled Furnaces . . . Superheaters . . . Economizers . . . Air Heaters . . . Pulverized-Coal Equipment . . . Chain-Grate Stokers . . . Oil, Gas and Multifuel Burners . . . Seamless and Welded Tubes and Pipe . . . Refractories . . . Process Equipment.

BABCOCK & WILCOX

THE BABCOCK & WILCOX CO.

85 LIBERTY STREET · NEW YORK 6, N.Y.

G-308 T

Like the Bureau of Standards units of measure preserved in Washington, a set of exact MASTER worms is preserved in the De Laval shops as a reference standard to assure unvarying uniformity in the production of worms and gears. For instance, without this MASTER WORM, in conjunction with special gauging devices, it would be difficult, if not impossible, to maintain the uniformity of thread thickness, preciseness of tooth contour and perfect inter-changeability of parts, strictly adhered to at De Laval.

Other manufacturers may make worm gears, but not all employ the precision methods responsible for the superior performance and long life of De Laval products. *Specifications alone do not make a worm gear.*

M-51

TURBINES • HELICAL GEARS and WORM GEAR SPEED REDUCERS CENTRIFUGAL PUMPS • CENTRIFUGAL BLOWERS and COMPRESSORS • IMO OIL PUMPS

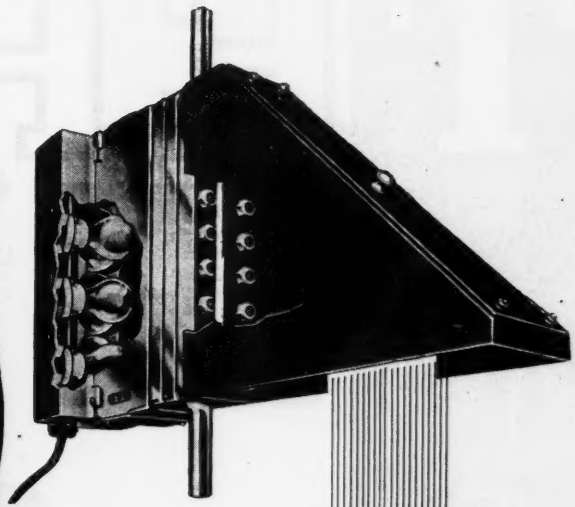
WORM GEAR DIVISION

DE LAVAL

STEAM TURBINE COMPANY · TRENTON 2, NEW JERSEY

SALES OFFICES: ATLANTA • BOSTON • CHARLOTTE • CHICAGO • CLEVELAND • DENVER DETROIT • DULUTH • EDMONTON • GREAT FALLS • HAVANA • HELENA • HOUSTON KANSAS CITY • LOS ANGELES • MONTREAL NEW ORLEANS • NEW YORK • PHILADELPHIA PITTSBURGH • ROCHESTER • ST. PAUL • SALT LAKE CITY • SAN FRANCISCO • SEATTLE TORONTO • TULSA • VANCOUVER • WASHINGTON, D. C. • WINNIPEG

DIAMOND
BI-COLOR
Water Gauge
AND ILLUMINATOR
Has Many Important Advantages



STEAM SHOWS
RED
AN EMPTY GLASS IS ENTIRELY RED

WATER SHOWS
GREEN
A FULL GLASS IS ENTIRELY GREEN

EASY TO READ

Image is so sharp and clear it can be mirrored to firing floor from any height—through as many as three grating runways without slightest confusion. Lower mirror can be made a part of boiler control panel.

SIMPLE TO INSTALL

Installation of the Bi-Color is very easy and it can be readily substituted for most existing water gauges, whether of Diamond or other manufacture.

ABSOLUTELY ACCURATE

Uses the simple optical principle of the difference in refraction (bending) of light rays passing through water and through steam. As instantaneous as the speed of light.

ALWAYS DEPENDABLE

Operation is as invariable and dependable as the laws of light under which it operates. No calibration is necessary. Variation in specific gravity of water has no effect.

NO MOVING PARTS

The Diamond Bi-Color uses no levers, bearings, pointers or fluids . . . it has no moving parts of any kind to require attention.

NO EXTRA PIPING

Because the Bi-Color is optical in its operation, no additional piping of any kind is required.

Write for **BULLETIN 892B**

DIAMOND POWER SPECIALITY CORP.
DETROIT 31, MICH.
DIAMOND SPECIALITY CORPORATION, WINDSOR, ONT.

TERRY

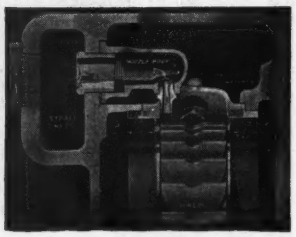
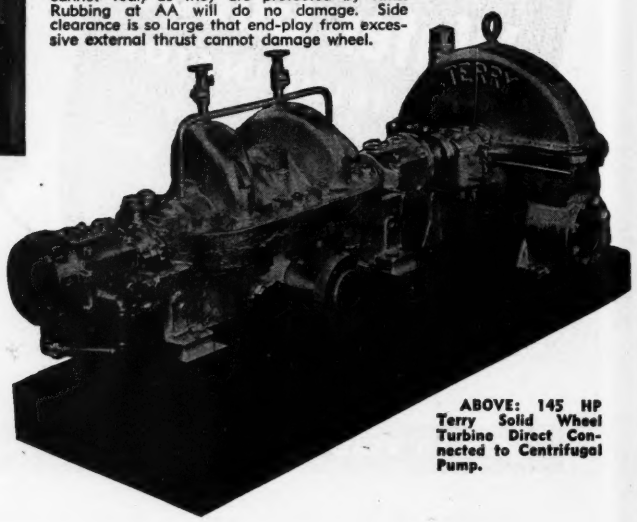


DIAGRAM SHOWING WHEEL CLEARANCES.
AA—Rim clearance, B—Large blade clearance, CC—Side clearance, (about one inch). Blades cannot foul; as they are protected by rims. Rubbing at AA will do no damage. Side clearance is so large that end-play from excessive external thrust cannot damage wheel.



ABOVE: 145 HP Terry Solid Wheel Turbine Direct Connected to Centrifugal Pump.

THESE LARGE WHEEL CLEARANCES INCREASE TERRY TURBINE DEPENDABILITY

In the Terry Wheel Turbine fine blade clearance is not essential to high operating efficiency. The actual clearance between the moving and stationary blades is greater than ⅛ inch. End play cannot affect this clearance and the side clearance is one inch or more. It is therefore not essential to make frequent adjustments of the thrust to maintain efficient and safe operation.

Clearance in the Terry blading may be reduced only by excessive wear of the main bearings, but even if this should occur, the projecting rims on the side of the wheel would rub on the smooth protecting surfaces of the reversing chamber, thereby automatically stopping the turbine before damage could result. Replacement of the interchangeable bearings immediately restores the original clearance.

T-1158

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . .

Check oil feeds to check wear and deposits . . . use

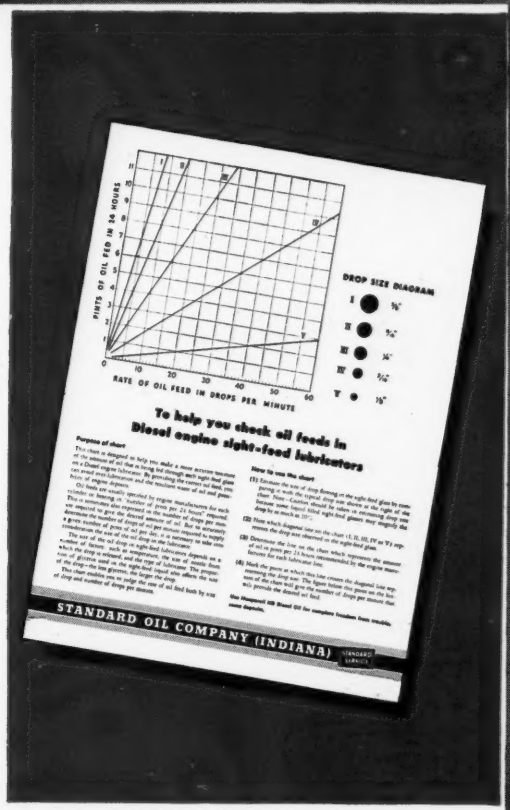
NONPAREIL HD
DIESEL OIL

Over lubrication or too little lubrication can be equally troublesome. The first may waste oil and cause excessive deposits. The second usually results in increased wear. Here are two ways to help you avoid all of these troubles.

The chart at right is designed as a guide in adjusting the oil feed in sight-feed lubricating systems. It enables you to check the amount of oil being fed to various engine parts by the size of the drop and the rate of flow in drops per minute.

With the right oil feed and Nonpareil HD Diesel Oil you can eliminate troublesome deposits and excessive wear. The book illustrated tells why the unusual oxidation inhibitor and detergent additive in Nonpareil keeps engines clean, rings free, and maintenance down on some of the most hard-worked, heavily loaded industrial Diesels.

You can get both the chart and the booklet without obligation by writing Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.


PINTS OF OIL FED IN 24 HOURS
RATE OF OIL FEED IN DROPS PER MINUTE
DROP SIZE DIAGRAM
I
II
III
IV
To help you check oil feeds in Diesel engine sight-feed lubricators
STANDARD OIL COMPANY (INDIANA)

This chart in full size is available to all Diesel engine operators. It will enable you to obtain a more accurate estimate of the amount of oil fed to Diesel cylinders and other engine parts. With it you can adjust oil feeds by the size of drop and the rate of flow in drops per minute. It will be helpful where engine manufacturers' recommendations simply state the amount of lubricant required in each 24 hours or where you want to check oil feeds in old lubricators.

Both the chart and booklet will be sent to you without any obligation. Simply write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

Buy and hold more Victory Bonds

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

★ LUBRICATION ENGINEERING

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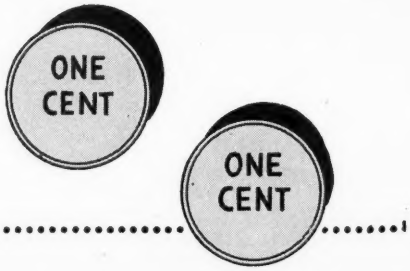
LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . .

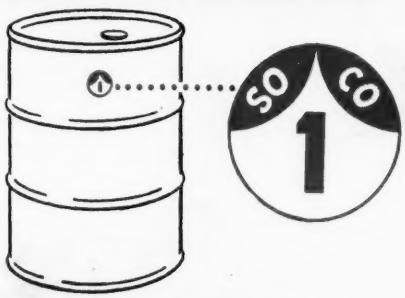
It's as easy as matching pennies

to get the right lubricant in the right places with Standard's

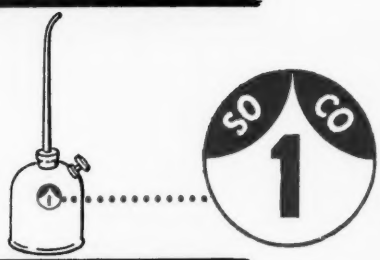


SO 1 CO CODED SO 2 CO LUBRICATION

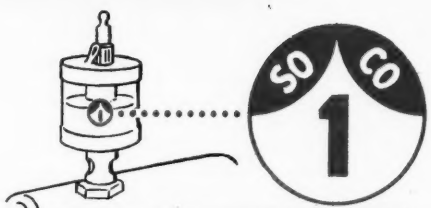
From storage container...



to oil can...



to oil cup...



by matching the numbers

● WITH Standard's Coded Lubrication, lubricants are handled from the drums or storage containers to oil cans or grease guns to the oil cups or grease fittings on equipment—by simple code numbers to identify them. It's easy to see how this eliminates the confusion of brand names and grades which your oiler must know—how it reduces the possibility of errors and the misapplication of lubricants which may result in damaged equipment or in applying expensive lubricants where they are not needed.

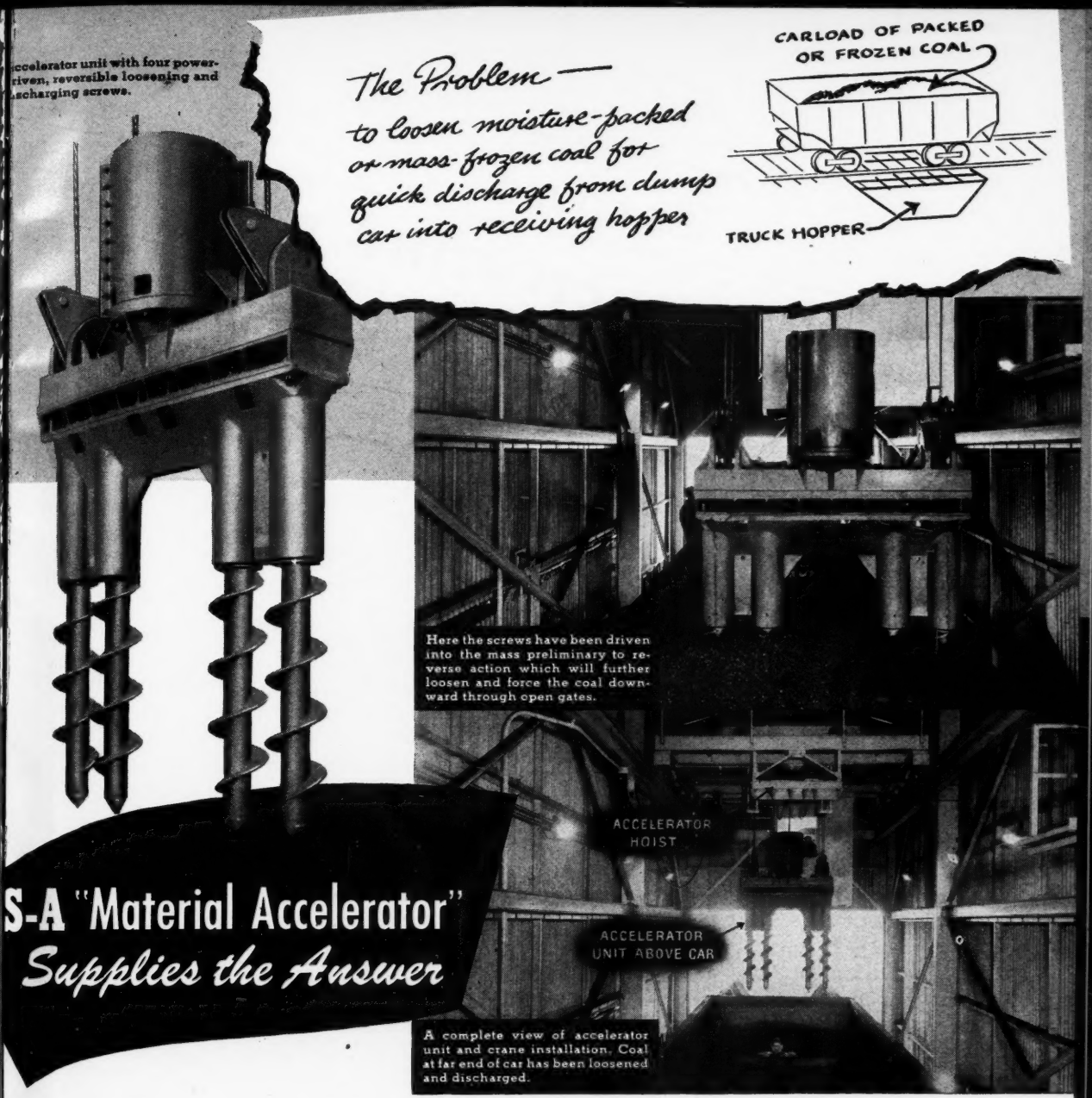
To install this system, you assign numbers to the lubricants used in your plant. Standard Oil will supply the numbered decals to be applied to the containers and lubricating spots. Now, when reconversion is in full swing, is a good time to plan on better, cost-saving lubrication.

A Standard Oil Lubrication Engineer will be glad to give you further information or consult with your lubricating men in the application of Coded Lubrication in your plant. This offer is available to all plants in the Middle West. Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

Buy and hold more Victory Bonds

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

★ LUBRICATION ENGINEERING


ccelerator unit with four power-
riven, reversible loosening and
scharging screws.
The Problem —
to loosen moisture-packed
or mass-frozen coal for
quick discharge from dump
car into receiving hopper
CARLOAD OF PACKED
OR FROZEN COAL
TRUCK HOPPER
Here the screws have been driven into the mass preliminary to reverse action which will further loosen and force the coal downward through open gates.
ACCELERATOR
HOIST
ACCELERATOR
UNIT ABOVE CAR
A complete view of accelerator unit and crane installation. Coal at far end of car has been loosened and discharged.

S-A "Material Accelerator" *Supplies the Answer*

Time and labor costs of car unloading were halved at one major power plant when S-A engineers recommended and installed an S-A Coal Accelerator.

This remarkable S-A unit consists of four power-driven, reversible broad-bladed screws operated from an overhead traveling crane.

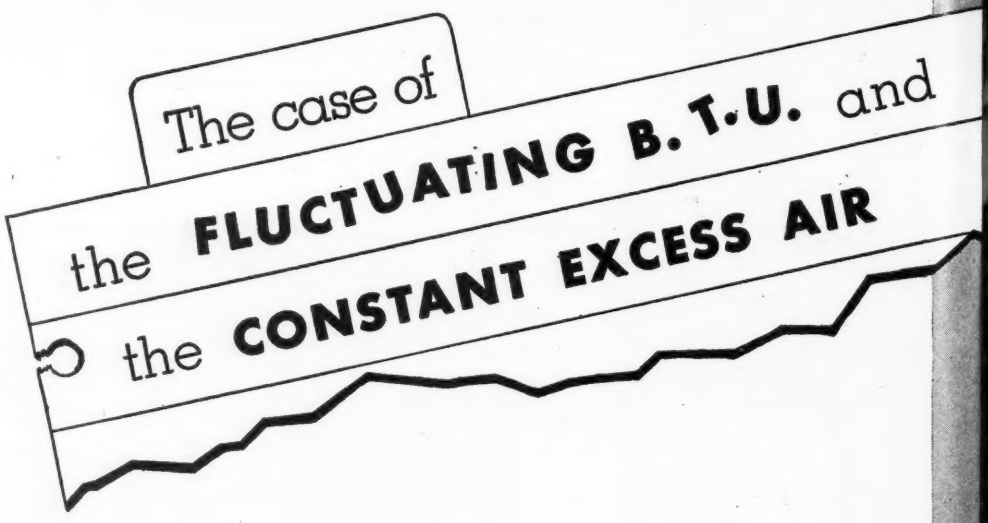
When packed or mass-frozen coal is encountered, the blades of the unit are screwed into it to their full depth. This action loosens the coal and when the rotation of the screws is reversed the coal is forced downward through the open gates of the car. The overhead crane permits spotting the unit over any section of the car where trouble is encountered.

STEPHEN S-A ADAMSON MFG. CO.

515 RIDGEWAY AVENUE, AURORA, ILLINOIS — LOS ANGELES, CALIF. ★ BELLEVILLE, ONT.

Designers and Manufacturers of All Types of

BULK MATERIAL HANDLING EQUIPMENT



For three years, the new boiler worked perfectly. Its rated capacity was 400,000 pounds per hour at 825 p.s.i. Two 12-ton per hour pulverizers supplied the fuel, and Hagan Automatic Combustion Control maintained proper steam pressure, furnace draft, and fuel-air ratio.

Throughout this period the plant had an assured supply of 13,000 B.t.u. coal, but early in the war it became necessary to supplement this with 10,000 B.t.u. coal from a nearby stripping operation.

Both types of coal might be in the hopper at the same time. The supply to the pulverizers at any moment might be either fuel, or any mixture of the two.

With a control system in which air supply is governed by rate of fuel feed, this might have been a serious matter, but with the Hagan Differential Master method it was no problem at all.

With this system the steam header Master Sender maintains heat input always equal to load demand, and the *Differential* Master Sender utilizes the boiler itself as a calorimeter of heat input to control air flow. Air is controlled in a positive, *direct* manner, not as an after correction.

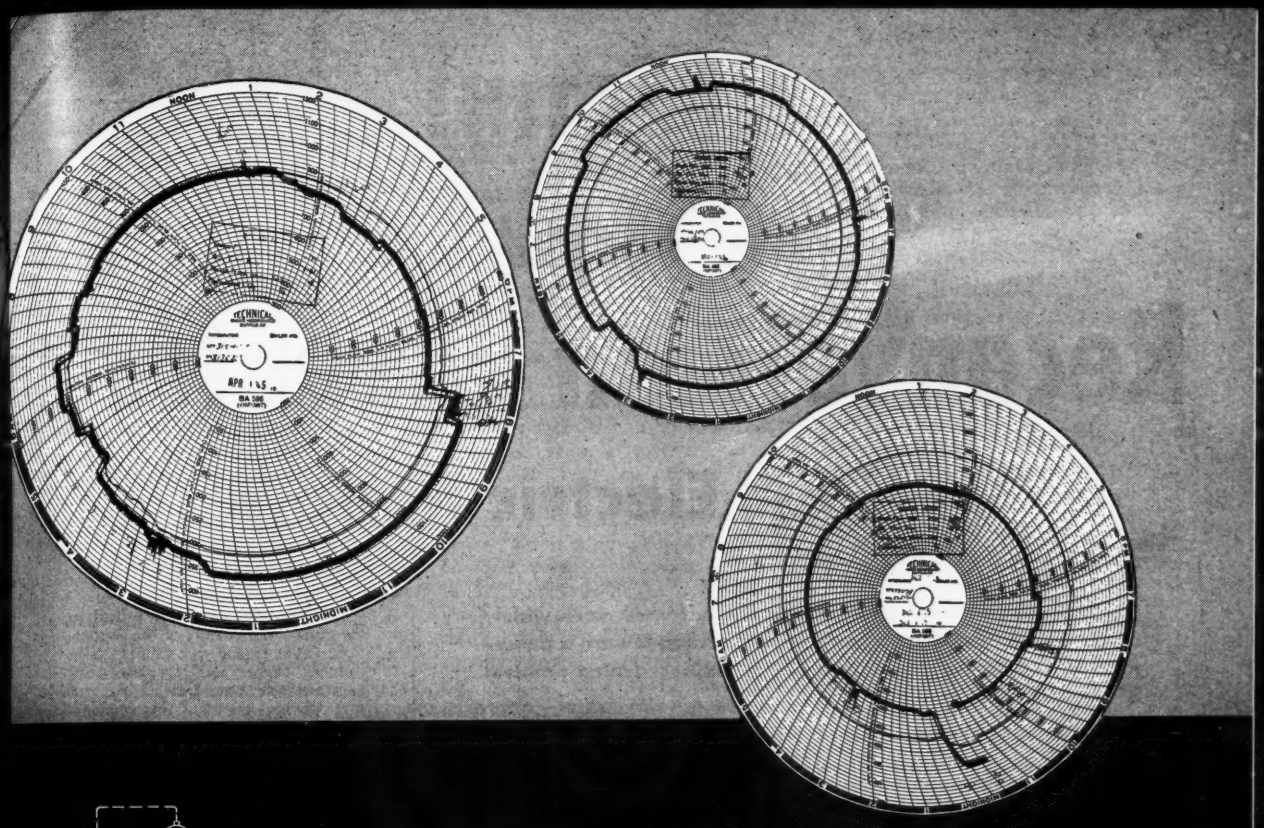
In the past three years, the Hagan Differential Master method has been successfully applied to boilers burning oil, gas, and pulverized coal; and ranging in size from 30,000 lbs./hr. at 200 p.s.i. to 650,000 lbs./hr. at 1800 p.s.i.

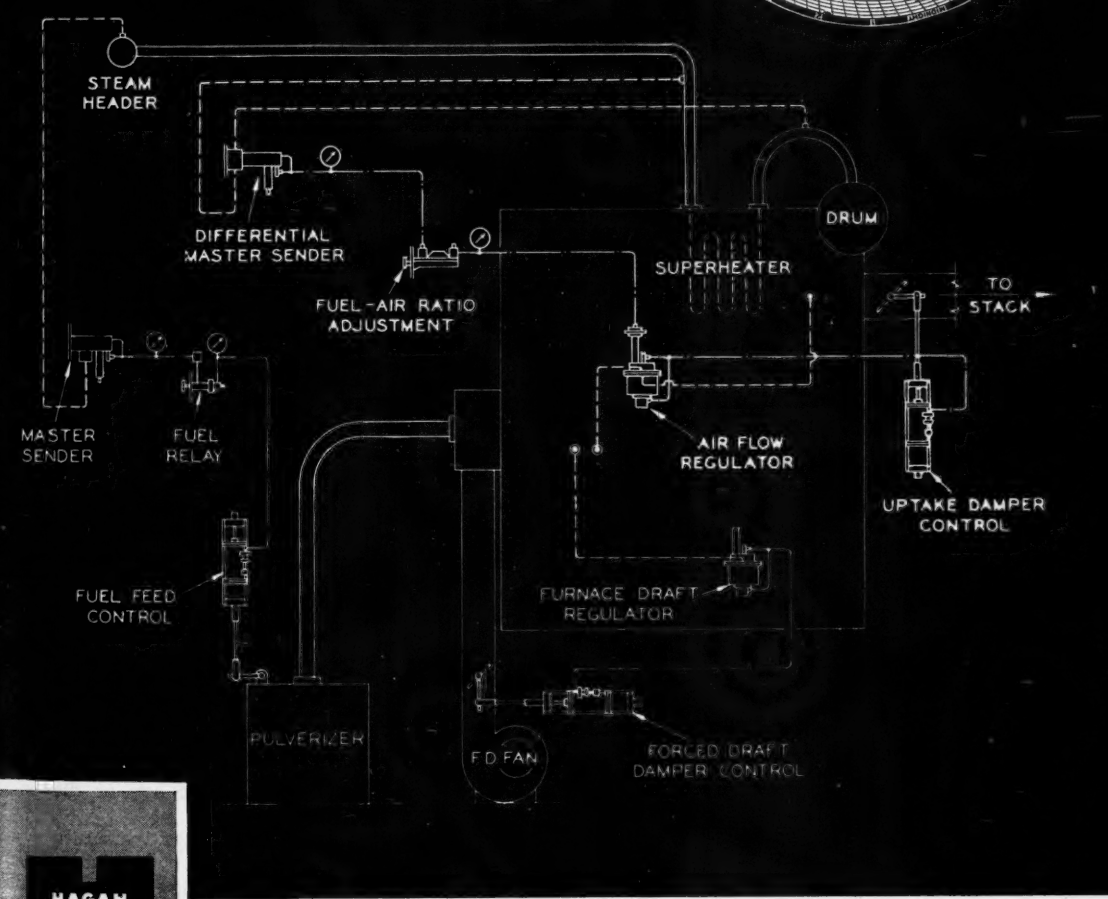
Our engineers will be glad to supply full information.

HAGAN CORPORATION, Hagan Building, Pittsburgh 30, Pa.

HAGAN *Automatic* COMBUSTION CONTROL

The pioneer . . . and still the leader





HAGAN
HALL
BUROMIN
CALGON

BULLETIN!

How to Take a Reconversion Inventory of Your Electric Motors

As new manufacturing equipment becomes more widely available, and as you reconvert your production toward a peacetime basis, you may be faced with an unprecedented problem of inventory-taking.

You may have to determine — more quickly than such a job has ever been done before — the exact condition of every piece of existing equipment you propose to use in peacetime production.

For about four years, far greater emphasis has been placed on setting production records than on keeping maintenance records; condition of equipment is often unknown. Because much equipment has been worked during wartime three and four times as many hours a year as in peacetime, calendar age may mean nothing. And repair has often depended on American ingenuity and baling wire.

Here are some of the standards you need to determine which of your electric motors: (1) are okay as is, (2) need repair or new parts, (3) will shortly require replacement, (4) need reapplication.

These standards generally apply to all makes of motors; when in doubt on any motor, consult its manufacturer.

1 START YOUR INVENTORY WITH THE RECORDS

Begin your motor inventory with the history of each motor; you'll save much time and effort... you'll be guided quickly to the units which most need attention. Written records and the mental recollection of foremen and maintenance men are the source of this information.

Check the *master maintenance records* (though in most plants this file is out-of-date and incomplete, because of wartime pressure on production); and get *reports from foremen* (in a small plant, it may be possible to interview each man; in a large plant, it may be more efficient to distribute blank forms, such as the "MOTOR CHECK LIST" on opposite page.)

Look into the service to which the motor has been subjected in wartime: has it been overloaded? underloaded? worked 3 shifts daily? allowed to go to work in spray, steam, flood, acids? has it had mechanical injury? has it stood idle, collecting moisture and dirt?

Knowing the answers to these questions will help you spot motors that may soon give you trouble... you can start your inventory there.

NOTE: All new motors built during wartime, under WPB limitation orders, contain minimum amounts of critical materials. Thus, unlike many prewar motors, they have been incapable of withstanding continued overload operation in the way you've come to expect high-grade American motors to do. Moreover, you've had to take motors at the ratings you could get, without much regard to the exact requirements of the application. Thus, many motors have been running harder and at higher temperatures than nameplate ratings call for. Obvious result of this combination of factors is shortened insulation life. So—*expect* trouble where wartime motors are misapplied.

2 THEN CHECK MOTORS IN OPERATION

Obviously, the easiest and most practical measure of a motor's present condition is the way it is now operating. You can't learn all you need to know about its probable future performance by observing it in use, but a motor does reveal certain symptoms of trouble while doing its job.

Check the power line voltage and frequency and compare with the voltage and frequency of the motor as stated on the nameplate. To perform properly, a motor must be supplied from a line whose characteristics correspond with those for which the motor was designed.

Check rpm — hand revolution counter makes this easy. Just remove cap, hold counter against end of shaft, and take a timed reading; compare with nameplate rating.

Take temperature readings — not by the "blistered hand" or "touch and yell" system, but *accurately*, with *thermometers*.

Find the temperature of the *motor* by taping or cementing thermometer to the stator iron... take the reading, and add 15°C. (The difference between the heat on the outside surface and the possible heat of the hottest part inside).

Compare motor temperature with temperature rise rating on the nameplate. Normally a 40° rise is considered acceptable; top temperature usually should not exceed 80°C.

Take the temperature of *bearings*.

either by taping or cementing thermometer to the bearing housing, or by inserting it into the oil well. In general, maximum safe bearing temperature is 96°C. (Bronze bearings may take somewhat higher temperature safely. When in doubt, consult motor manufacturer.)

Listen for — EXCESSIVE HUM. May be caused by uneven air gap, and may call for replacement of bearings. Or it may be caused by loose laminations or unbalanced rotor. Note this hum while inspecting motor in operation; check for cause later, while making inspection of parts.

Note — VIBRATION. If excessive, this may be caused by either misalignment between shafts of motor and driven machine, or through transmission of vibration in driven machine to the motor. Run motor disconnected for check. *If vibration follows motor repair,* it's probably due to out-of-balance rotor.

Listen for — RAPID KNOCKING. May be caused by misalignment, with shoulder of shaft pounding against bearing end; realign set . . . and note this knock, check bearings when making inspection of parts.

NOTE: if excessive vibration, knock, or squeal follows re-assembly of motor, cause may be incorrect axial adjustment for float.

Look for — EXCESSIVE SPARKING OF BRUSHES. Check for cause when motor is taken down for inspection.

3 THEN CHECK THE PARTS

If time permits, you'll want to give detailed inspection to *every* motor that's been in strenuous service these past years. (You may be able to work this into your regular production schedule. Set up a system so that the electrical department may be notified whenever a machine is to be down. Disassembly and inspection of motors can be done then.)

And in cases where *history* of the motor or its *operating characteristics* indicate the likelihood of present or future trouble, you'll surely want to take a close look at the parts themselves.

A. FIRST — disconnect motor leads and uncouple motor from driven unit.

B. THEN — if excessive hum was noted while motor was in operation, use feeler gauge to check air gaps between rotor and stator. Difference of more than 20% indicates overworn bearings, sleeves, or journals. Check bearings as indicated below.

C. REMOVE end housing and lift rotor out, using a sling if rotor weighs over 75 pounds. If rotor is dirty, clean it with air hose (pressure not over 30 lbs), bellows, or vacuum cleaner, or swab it with non-inflammable solvent.

D. INSPECT rotor for abrasion; corrosion; discoloration (caused by overheating.) In squirrel cage motor, check also for loose or broken rotor bars.

E. IF ROTOR or armature is the wound type, check for loose banding. If any looseness is noted, band with new wire before putting motor back in service. If band assembly has not failed extensively — perhaps only a solder failure at one or two clips — repair can usually be effected simply by resoldering. Major rebanding, however, is a job for experts.

F. CHECK INSULATION — As motors get older, or as they operate continuously at high temperatures, insulation on coils tends to become brittle. It may start flaking off, cutting its insulating value. This may not affect motor performance seriously *except* that it may lead to short circuits or grounds, excessive vibration (out-of-balance rotor), or clogging of the air vents (leading to overheating) or abrasive wear from fallen particles. SO — check insulation visually . . . see whether pieces of insulation have torn or flaked off . . . and also make a megger (megohmeter) test. For a clean, dry motor at 75°C, insulation resistance in megohms, according to the American Standards Association, may be found by the formula:

$$\frac{\text{Rated voltage of motor}}{\text{Rating in KVA}} + 1000 = \text{Insulation Resistance in Megohms}$$

G. CHECK BEARINGS — to remove ball bearings, use a puller, applying pressure to the inner race only, maintaining uniform pull all around, to avoid distorting the bore of the race.

Check bearings for excessive wear, scoring, or pitting.

To examine *anti-friction bearings,* first clean them thoroughly with kerosene to remove all old grease and dirt particles; then hold inner race and rotate outer race, feeling for roughness of action and listening for noise.

Inspect sleeve bearing clearance with feeler gauge. Normal clearances may be computed this way: take 0.003" as the basic tolerance . . . then add 0.001" for each inch of shaft journal diameter. Inspect journal surfaces; if scoring seems excessive, consider replacing.

If bearing shows no excessive wear, the hum of the motor in action may result from out-of-balance rotor or armature. Check this on parallel bars.

H. CHECK for cause of sparking. Check mechanical condition of parts. (For details, see Reconversion Inventory Kit, offered below.)

4 NOW MAKE THE APPRAISAL

With all the facts in hand — history, operating characteristics, condition of parts — your electrical department will be best prepared to assign this motor to its new role in reconverted production. Use check list forms like this —

RECONVERSION INVENTORY CHECK LIST FOR ELECTRIC MOTORS

for easy inspecting and appraising. Your nearby Allis-Chalmers district office or distributor will supply free copies of this Check List in whatever quantity you require.

CENTRIFUGAL PUMPS, V-BELT DRIVES, NEED INVENTORY TOO!

To speed your Reconversion Inventory of the most common industrial units, Allis-Chalmers has prepared a Reconversion Inventory Kit covering Electric Motors, Centrifugal Pumps, and V-Belt Drives. No big package, this kit is simply a set of Fact Sheets and Check Lists covering each type of unit, with suggestions for inventory procedure as outlined in these pages, but in somewhat greater detail.

A 1901

GET THESE FREE FORMS

For your supply of Reconversion Inventory Kits, covering motors, pumps, and v-belt drives, call your nearest Allis-Chalmers district office or distributor or write Dept. 410, ALLIS-CHALMERS MFG. CO., MILWAUKEE 1, WIS.

ALLIS AC CHALMERS

Here are the benefits you get from

BAILEY CONTROLS

1. **Fuel Conservation without decrease in output.**
2. **Lower Cost Steam.**
3. **Increased Safety for Plant and Personnel.**
4. **Better Power Service.**

Bailey Controls for boilers make the important factors of steam plant operation work together to insure ideal performance.

In order that all of these factors may be regulated in harmony with each other and the load demand, Bailey Controls are carefully engineered to the requirements of the units which they serve.

Bailey engineering service starts with the selection of suitable metering and control equipment and continues through the design, construction, calibration, installation and final adjustment on the job. Bailey field engineers are stationed in over thirty industrial areas throughout the United States and Canada for the purpose of rendering prompt "on the spot" engineering service without undue traveling expense.

The Bailey engineer in your community has extensive experience at his command, which includes tests on thousands of boiler installations, covering a wide range of fuels, furnaces and fuel burning equipment. He is in a position to help you secure the many benefits resulting from intelligent use of correctly selected and properly applied boiler control.

Bailey Controls for boiler operation are described in Bulletin 15-C. Write for your copy to Bailey Meter Company, 1040 Ivanhoe Road, Cleveland 10, Ohio —in Canada to Bailey Meter Company Limited, Montreal.

FUEL CONVERSION

If it becomes desirable or necessary to convert to another fuel, Bailey Controls can be adjusted easily to insure optimum results from the new fuel.

G-26

BAILEY METER COMPANY

1040 IVANHOE ROAD • • • • CLEVELAND 10, OHIO

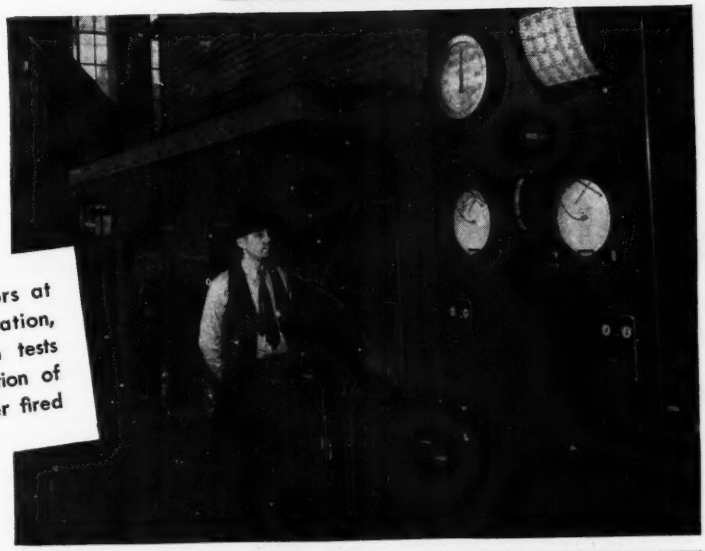
COMBUSTION • PRESSURE
FEED WATER • LIQUID LEVEL
TEMPERATURE • FEED PUMPS

Controls for Steam Plants

APPLICATION to STOKER FIRED BOILERS

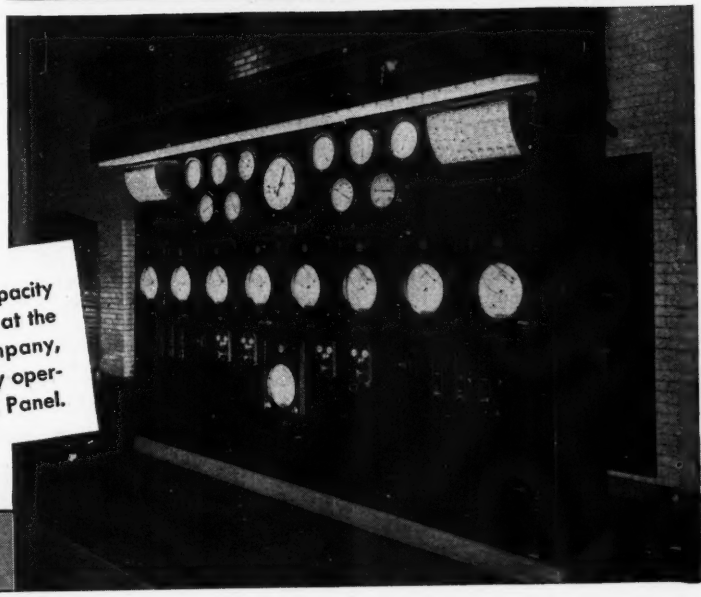
UNDERFEED

This Bailey Control Panel insures optimum performance from three underfeed stokers on two 25,000 and one 40,000 lb. per hour capacity boilers at Parker Appliance Company, Cleveland, Ohio.



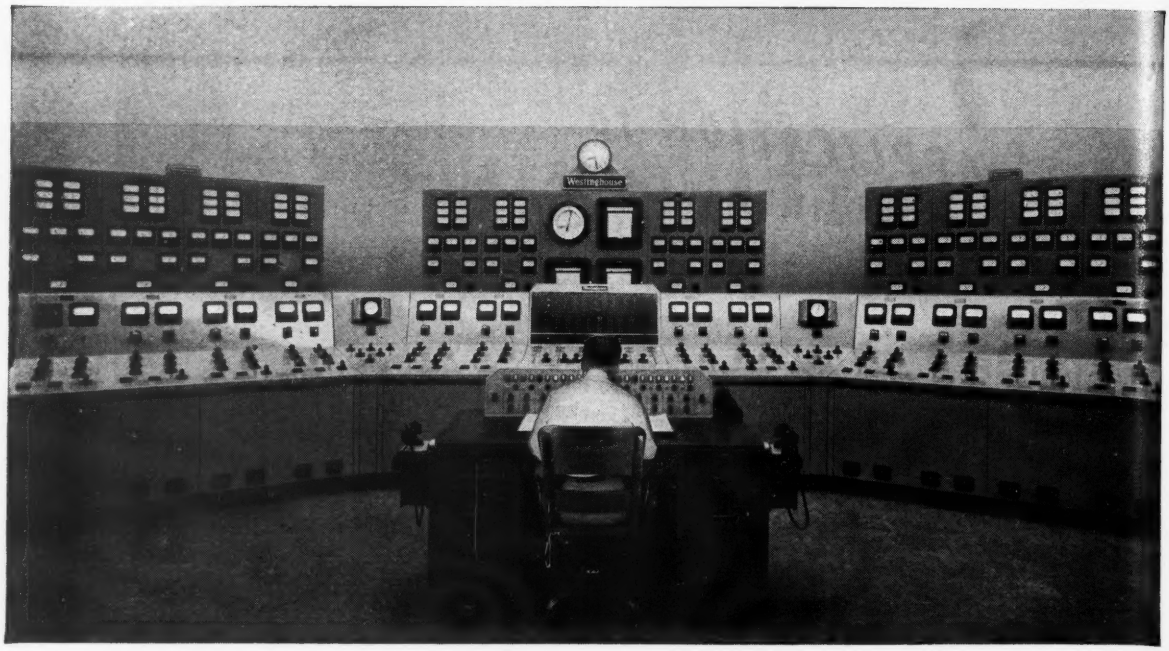
SPREADER

Bailey Controls help operators at Graham-Paige Motors Corporation, Detroit, Michigan, to maintain tests standards in everyday operation of this 60,000 lb. per hour boiler fired by a spreader type stoker.



CHAIN GRATE

Two 40,000 lb. per hour capacity chain grate stoker fired boilers at the United States Tobacco Company, Chicago, Illinois, are efficiently operated by this Bailey Control Panel.



Switchboard in Control Room of Aluminum Co. of Canada's Shipshaw Powerhouse. Note how signal lights and Micromax Recorders are centralized in operator's triangle of vision, with all switches for the Station's hydro-generators at the sides.

SHIPSHAW OPERATOR
Watches Generators via Micromax Recorders

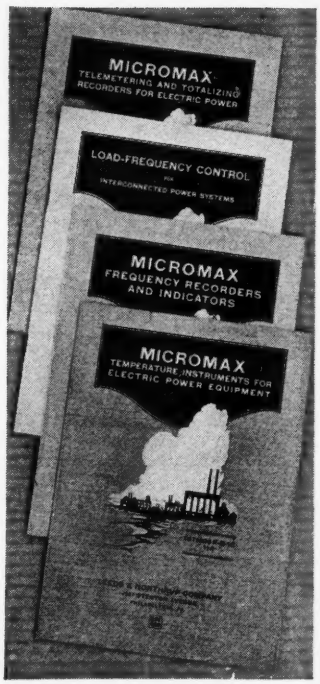
The instruments in Shipshaw Powerhouse's Operating Room are noteworthy for the quick, compact way in which they enable the generation operator to watch the Station's three interrelated conditions of frequency, load and generator temperature.

The Round-Chart Micromax Recorder, just below the clock at the left, shows the frequency.

Beside the Round-Chart Frequency Recorder is a Micromax Strip-Chart Load Recorder. This instrument totalizes the megawatt output of Shipshaw's twelve units.

Below the Frequency and Load Recorders are two Micromax six-point Generator Temperature Recorders; only the top halves are visible in the photograph. Each shows the stator temperatures in 6 generators, and warns if the ultimate load-limit is reached, regardless of power factor, ambient temperature or any other contributing factor.

Thus the four Recorders tell the story of what the twelve turbo-generators are doing, and tell it in the way best calculated to help the operator perform his twin duties of carrying the station load and protecting the machines.



Any or all of these L&N publications will be sent on request, but if you have a problem to which an L&N Recorder or Controller may be applied, we suggest you call in an L&N engineer for specific recommendation.

LEEDS & NORTHRUP COMPANY, 4973 STENTON AVE., PHILA. 44, PA.

LEEDS & NORTHRUP

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

Jrl. Ad N-161(7)

COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company "Bridgeport" *Headquarters for BRASS, BRONZE, and COPPER*

Now is the time to Modernize and Retube Surface Condensers

Although the sudden cessation of the war has brought a number of problems to power plants operating in districts which were busy with war work, it is with a sigh of relief rather than with regrets that the power plant engineer faces the future.

He has learned to operate under difficult conditions such as a shortage of maintenance men, lack of adequate fuel supplies, and worn-out condenser tubes, which in normal times would have long since been scrapped. Now is the time to take a careful inventory of assets and liabilities so that maximum efficiency can be obtained.

Every operator must challenge equipment and materials. What provisions should be made for the continued increase in water contamination and the use of constantly higher water velocities? To be more specific, which condenser tube alloy will give maximum efficiency and economy today and in years to come?

The problems which face the power plant operator are not unlike, in some respects, those which industrial companies must meet to reconvert for peacetime manufacture. Obsolete and worn-out equipment must be removed and replaced with the most modern and efficient types. Every effort must be made to develop a plant which operates with greater economy than was possible before the war in order to compensate for rising labor costs.

New Alloys Are Undergoing Service Tests

A number of power plant engineers have been investigating the newer alloys by permitting sample lots of tubing to be installed in their condensers and watching the results under conditions of operation which in most cases have been more severe than normal. We have in mind results obtained by a seaboard power station which installed some DURONZE IV (arsenical aluminum bronze) in their condensers eight years ago. At the end of this period DURONZE IV showed very slight corrosion. This corroborated laboratory and field tests which have clearly indicated the superiority of this alloy. As a result of this test it was decided to retube other units with DURONZE IV.

There are other characteristics of DURONZE IV which, no doubt, affect the overall efficiency of condenser operation. DURONZE IV has less tendency to scale. Its protective film, which is deposited on the inside of the tubes, is thin and has less tendency to reduce heat transfer properties. Good heat transfer characteristics are therefore maintained over a long period with correspondingly higher operating efficiency.

During the war the government specified 70-30 cupro nickel for condensers on war ships. This alloy is excellent for marine operation involving high velocities and water turbulence. No doubt much cupro nickel will now be used for peacetime operation on fast turbine-driven passenger ships and merchant ships, as well as in seaboard power plants.

Selecting The Correct Alloy

As to which alloy will give the best results, the answer to this question depends to a great extent upon the designer and operator of the condenser. We all recognize the destructive part which corrosion plays. Our laboratory devotes much effort to corrosion research studies, field and service tests. Cooperation with operators has brought in important facts which have been helpful in the correct selection of the alloys which give the best results under a particular set of operating conditions.

Corrosion research has not only enabled us to evaluate the corrosion resistance of our present alloys but has made possible the improvement of existing ones and the development of new ones. Since the results of tests made under actual conditions consume considerable time, both the operator and the laboratory man must be extremely patient. However, when results are finally obtained, the dividends are worth waiting for.

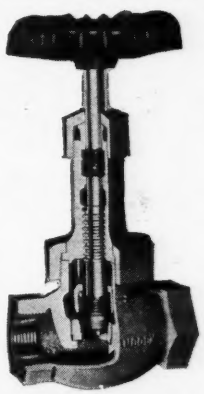
In our Condenser Tube Manual we list the various condenser tube alloys which are available and their properties and applications. We have also included some corrosion research studies, specification data and numerous valuable tables. If you have not received a copy of this comprehensive manual be sure and write for one without delay.

Developments during the past few years have opened up even more possibilities for the use of electric power. Electrically energized machines, appliances and equipment will serve industry and private homes to an ever-increasing extent. An extended program of rural electrification will still further increase power requirements. The future is bright for electricity and the power plants which produce it.

Hancock Valve Improved by Duronze III

The fundamental truth that no chain is stronger than its weakest link is being applied to an increasing extent in many fields of engineering and design. Product designers are showing an increasing tendency to improve their products by strengthening vulnerable parts through the more generous use of modern engineering alloys.

In their featured "500 Brinell" bronze valve, Hancock Valve Company is using DURONZE III (silicon aluminum bronze) for the stem. Here the qualities of hardness, high strength (more than 85,000 psi annealed) as well as resistance to wear and corrosion have increased the life and usefulness of this well-known valve. It is reported that the DURONZE has outlasted other previously-tried materials more than 6 to 1.



Cutaway view of Hancock Valve shows valve stem of Duronze III

DURONZE III is used for high-strength screw machine items, valve and pump parts, electrical connectors, bolts, screws and other fasteners, worm gears, rollers and sliding parts. Bridgeport's 80-page Duronze Manual contains valuable technical data and suggested applications for DURONZE silicon bronze and aluminum bronze alloys. Write for your copy today.

Note: Bridgeport products are supplied in accordance with existing priority regulations.

BRIDGEPORT BRASS

BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN.

ARMY E NAVY

BRASS

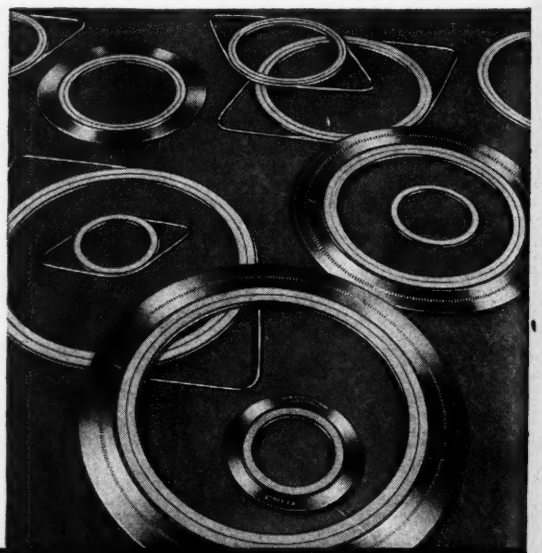
ESTABLISHED 1865

"Flexitallic"

REG. U. S PAT. OFFICE

ARMY E NAVY

the Gasket that solves
BOLT TENSION PROBLEMS
. . . and thus minimizes the most common cause of
GASKET FAILURE



(1) Flexitallic Gaskets of balanced, spiral-wound construction are easier, quicker to install because bolt tension is automatically controlled by gasket yield. Tension gauges or similar devices are unnecessary.

(2) Special on-the-job hand finishing of bolting surfaces is seldom necessary. Flexitallic spiral-wound construction is specifically designed to do what good gaskets are supposed to do — *compensate for minor inaccuracies.*

(3) No other gasket can surpass Flexitallic for precision manufacture balanced with service requirements for high or low temperatures, high or low pressures, gases, chemicals or other difficult operating conditions.

FLEXITALLIC GASKET COMPANY

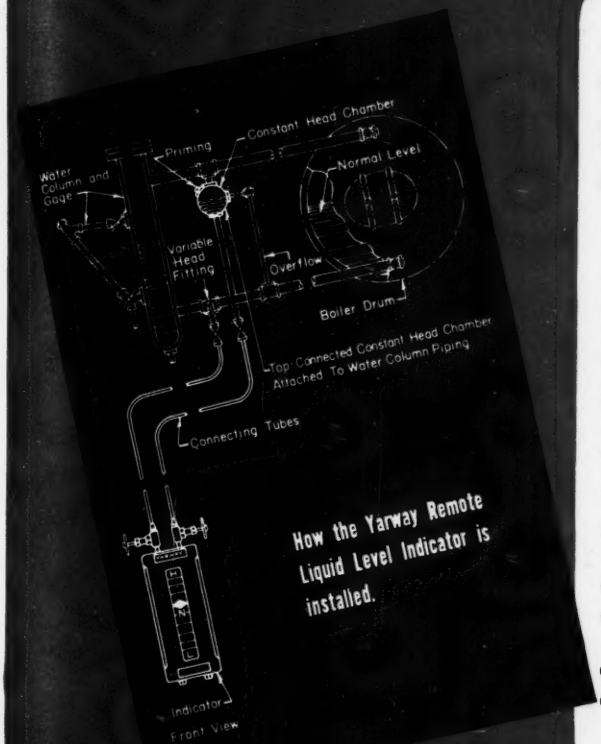
Originators of Spiral-Wound Construction

8TH & BAILEY STREETS, CAMDEN, N. J.

CUSTOM BUILT FOR ANY TEMPERATURE — ANY PRESSURE

including the 2500 lbs. A. S. A. Series

The "EYES" HAVE IT!



How the Yarway Remote Liquid Level Indicator is installed.

CONSTANT, ACCURATE BOILER WATER LEVEL INDICATION ON INSTRUMENT PANEL OR OTHER CONVENIENT EYE LEVEL LOCATION

Boiler plant operators are voting for the new Yarway Remote Liquid Level Indicator . . . and no wonder!

Here is an instrument that brings overhead gage readings right down to eye level on a brilliantly-lighted red and green scale. No more straining, squinting and guessing at hard-to-see boiler water levels. The Yarway Indicator gives constant, positive, clearly visible indication at all times.

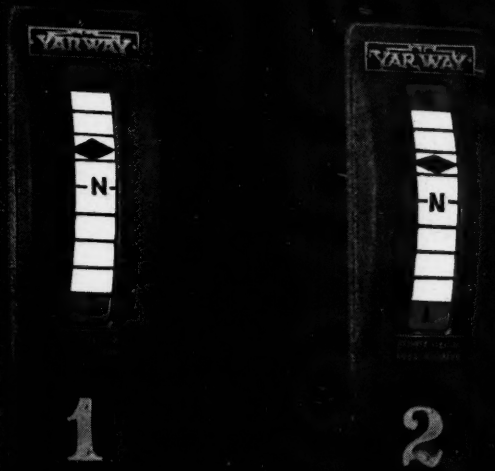
Check these unique advantages:

- No special liquid required . . . instrument operated by the boiler water itself.
- No glass under pressure.
- No packing or stuffing boxes . . . practically frictionless.
- No oiling or adjustment required.
- Luminous pointer and dial letters "H" and "L" insure clear readings even in total darkness.
- Shows water level beyond range of conventional overhead gage glass and always indicates "High" or "Low"—even when full or empty gages look the same.
- Suitable for all pressures up to 1500 psi.

Already nearly 3,000 Yarway Remote Liquid Level Indicators have been sold. Ideal not only for boiler water level indication, but also to indicate feed-water-heater levels, and other liquid levels. Ask for Bulletin WG-1820.

YARNALL-WARING COMPANY
114 MERMAID AVENUE, PHILADELPHIA 18, PA.

Have you seen "There Is An Engineering Reason," Yarway's new 30-minute color and sound motion picture with Lowell Thomas speaking? It's now available for group showings. Write for information.



YARWAY REMOTE LIQUID LEVEL INDICATOR

HOW BETZ
double checks plant control tests

No. 5
in a series of advertisements outlining the fundamentals of Betz service.

WATER ANALYSES FROM THE LABORATORIES OF **W. H. & L. D. BETZ**
GILLINGHAM AND WORTH STREETS PHILADELPHIA 24, PA.

For: [redacted] Manufacturing Company
Camden, New Jersey

Sample Dated: 6/14/45

SAMPLE MARKED	Raw Water	L-S Softener Effluent	Feed Water	Boiler No. 1	Boiler No. 2	Boiler No. 3	Condensed Steam
ANALYSIS NUMBER	D5218	D5219	D5220	D5221	D5222	D5225	D5224
Turbidity as SiO_2, ppm	75	8	5	Present	Present	Present	Clear
Oil, ppm			1.2				0.2
Ammonia as N, ppm							16
Carbon Dioxide as CO_2, ppm							0
Total Hardness as $CaCO_3$, ppm	152	14	14	0	0	0	
Calcium as $CaCO_3$, ppm	110	12					
Magnesium as $CaCO_3$, ppm	42	2					0
Phenolphthalein Alkalinity as $CaCO_3$, ppm	0	44	44	336	338	316	6
Methyl Orange Alkalinity as $CaCO_3$, ppm	98	64	68	448	460	456	0.0
Sulfate as SO_4, ppm	36	30	24	368	370	352	0.0
Chloride as Cl, ppm	22.5	19.5	18.5	298	290	272	
Silica as SiO_2, ppm	10	6					
Phosphate as PO_4, ppm					55	45	70
Sulfite as SO_3, ppm					25	32	32
pH	6.1	9.9	9.9	11.5	11.5	11.5	6.0
Specific Conductance, micromhos				1910	1920	1840	6.5
Specific Conductance, micromhos (corrected)							1.3
Blowdown, %					6.2	6.4	6.8
2P-M, ppm			24				
M-H, ppm			50				

● Betz supervisory boiler water control service leaves nothing to chance. There are no mere guesses or assumptions that conditions are satisfactory at the plant. Thus, in addition to regular personal visits by Betz engineers and daily testing by the boiler plant operators, we also "double-check" by means of more complete analyses in our own laboratories.

At regular intervals, water samples from all important points throughout the system are secured by our engineers and forwarded to our headquarter laboratories. Here, trained chemists conduct careful and complete analyses on each sample. A report, as shown on the opposite page, is then submitted to the plant. In many cases these "check analyses" reveal conditions which may not be evident from plant control tests. Such complete laboratory analyses enable our Engineering Department to make corrective recommendations *well in advance*, thereby heading off any serious trouble which might otherwise develop.

This added feature of Betz supervision is a service that can be extended only by an organization equipped with modern laboratory facilities. At our headquarter laboratories in Philadelphia we conduct over 45,000 "check analyses" each year. This is an essential part of a service which assures our clients a complete protection against unscheduled boiler outages.

W. H. & L. D. BETZ

Gillingham & Worth Sts., Philadelphia 24, Pennsylvania

THE 6 FUNDAMENTALS OF BETZ BOILER WATER CONDITIONING SERVICE

1. Complete plant investigation and report.
2. Establishment of plant control.
3. Daily plant control tests.
4. Detailed review of plant tests and report.
5. **Supplementary complete laboratory analyses.**
6. Periodic "check-up" visits.

CHEMICAL ENGINEERS—
CONSULTANTS ON ALL WATER PROBLEMS

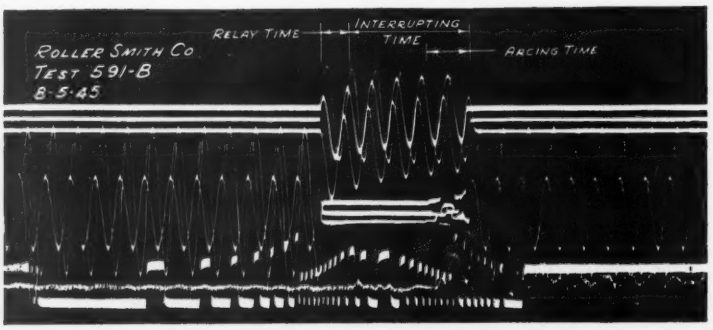
BETZ

ROLLER SMITH

"ON THE LINE" TEST STATION PROVIDES KEY TO SECRETS OF ARC EXTINCTION

THE new Exotherm principle of arc extinction discovered by Roller-Smith engineers puts arcs out faster because it harnesses the properties and energy of the gases produced when the arc is struck.

The discovery of the Exotherm principle grew out of the efforts of Roller-Smith engineers to reconcile conventional laboratory tests of breakers with performance "On the Line." The only answer seemed to be "On the Line Testing" of breakers. Through cooperation of the utility industry the first "On the Line" test station of its kind was established by Roller-Smith to seek out the real facts about oil circuit breaker performance. Because the tests were conducted under actual operating conditions, the full value of recovery voltage, both normal and transient, came into play. For the first time conflicting theories and claims about arc extinction could be tested under actual service conditions. After hundreds of tests "On the Line," provided information never before available, the Exotherm principle of arc extinction was discovered. A chamber in which the arcing takes place confines the gas, compresses it, and correlates the thermal and pressure characteristics to obtain rapid arc extinction.



Typical test oscillogram of Roller-Smith oil circuit breaker employing Exotherm principle. Note 5 cycle interrupting time.

Roller-Smith oil circuit breakers with the Exotherm principle give consistent 5 cycle operation; little or no burning of contacts and low pressures inside the tank. 5 cycle operation means better protection to equipment with resulting savings. Making use of the arc energy results in less contact burning and less oil sludging, saves inspection and maintenance. Low tank pressure results from the Exotherm principle because the gas is cooled and contracted before it gets into the tank. The result —far greater safety for indoor operation than ever before.

For full information on the Exotherm principle applied to Roller-Smith oil circuit breakers, write to dept. PPE.

ROLLER SMITH

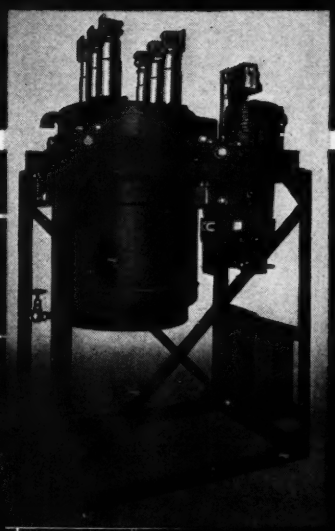
Oil Circuit Breakers

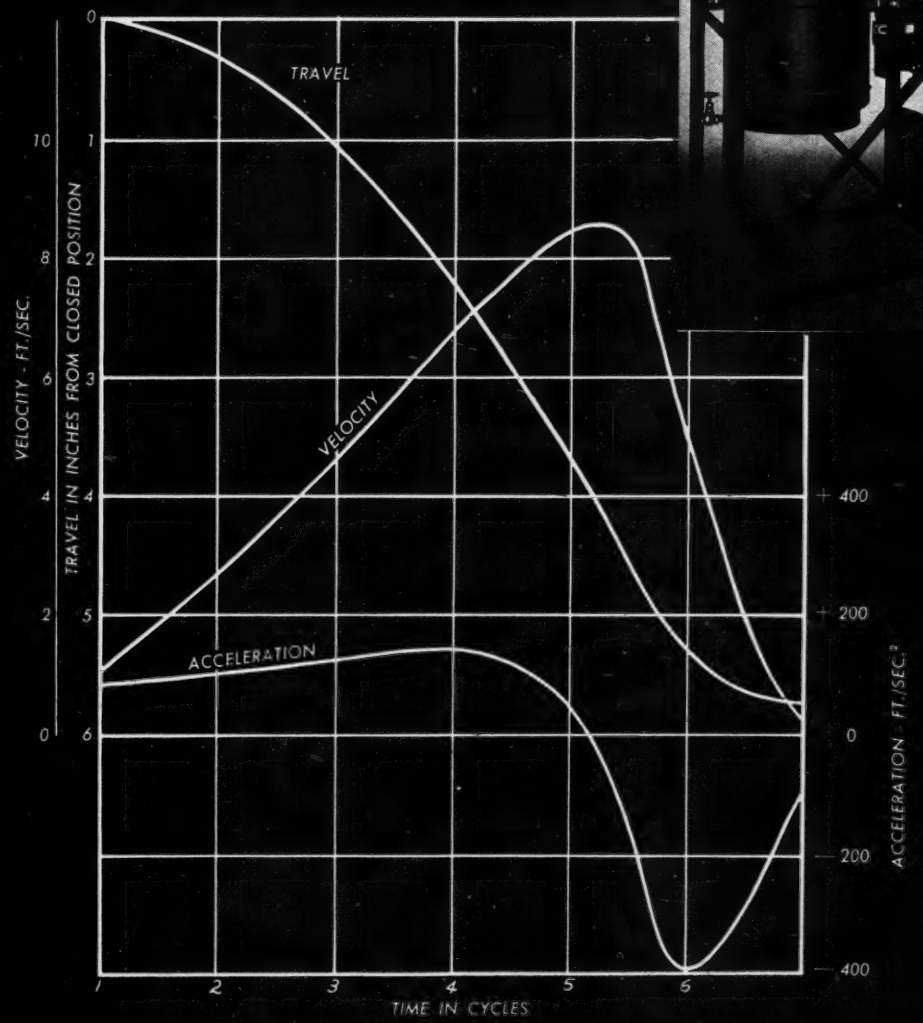
BETHLEHEM • PENNSYLVANIA

In Canada: Roller-Smith Marsland, Ltd., Kitchener, Ontario

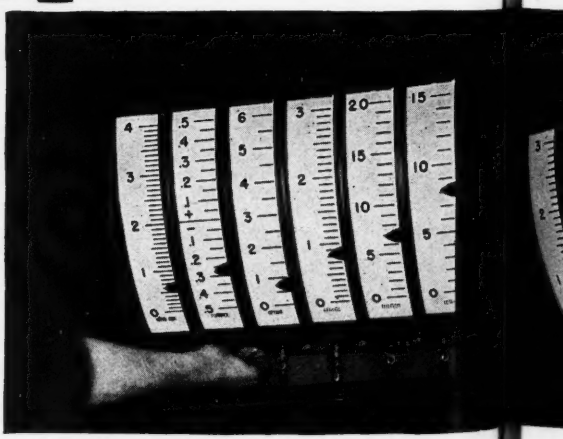
STANDARD AND PRECISION ELECTRICAL INSTRUMENTS • AIRCRAFT INSTRUMENTS • SWITCHGEAR
AIR AND OIL CIRCUIT BREAKERS • ROTARY SWITCHES • RELAYS • PRECISION BALANCES

Announces




TRAVEL
VELOCITY
ACCELERATION
VELOCITY - FT./SEC.
TRAVEL IN INCHES FROM CLOSED POSITION
ACCELERATION - FT./SEC.²
TIME IN CYCLES
0
2
4
6
8
10
1
2
3
4
5
6
+ 400
+ 200
0
— 200
— 400

YOU GET



Just tilt the bezel flange and all zero adjustment knobs, connections, etc., are at your finger tips.

ALL OF THESE FEATURES

In The Republic Multi-Point Draft and Pressure Gage

1. EASY TO OPERATE: All adjustments can be made from the front of the gage regardless of whether it be flush or projected mounted. On the flush mounted gage a bezel flange, which tilts back, conceals the zero adjusting knobs, pipe connections, mounting bolts, etc.

2. INDIVIDUAL UNITS: Each draft or pressure element is individually housed in a die cast case forming a complete compact unit.

3. UNITS EASILY REMOVED: The individual units can be removed from the front of the gage as you would remove a book from a shelf. This can be easily and quickly done without interfering with the operation of any other unit.

4. EASY TO MAINTAIN: Because each element is a complete unit in itself which can be easily removed, maintenance is greatly simplified.

5. INDIVIDUAL ILLUMINATION: Each scale is individually illuminated from the back by a light located outside of the element housing.

6. UNIFORM SIZE: All units are of one standard size which permits new units to be added or interchanged as required.

7. ALL STANDARD RANGES: Elements are supplied for all standard ranges of draft, pressure or differential.

8. SENSITIVE DIAPHRAGM: All elements, except those for high pressures, are actuated by an extremely sensitive bellows type of diaphragm.

9. MULTIPLE UNITS: Any number of units of draft, pressure or differential may be combined in one multi-point gage which is supplied for either flush or projected mounting.

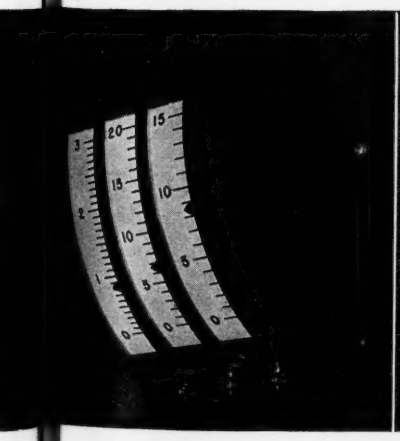
10. FLOW, CO_2, TEMPERATURE: Developed primarily to indicate drafts, pressures and differentials, the Republic multi-point gage can also be made to indicate other quantities such as flow, CO_2, temperature, liquid level, etc. In each case the corresponding standard Republic instrument is used.

The sectional view shown on the opposite page illustrates the extreme simplicity and compactness of the Republic Multi-Point Draft and Pressure Gage. Every detail has been designed to assure ease of maintenance and continuous operation as well as accuracy and sensitivity.

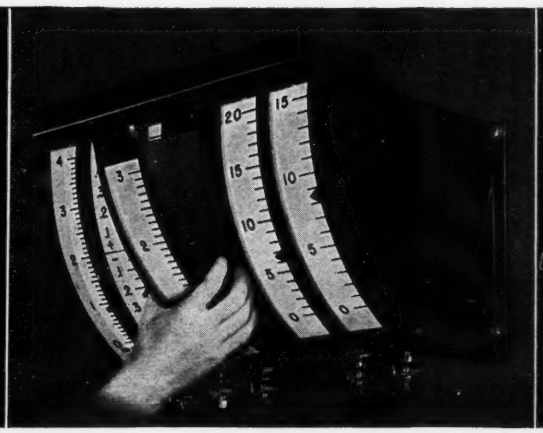
Write for a copy of Bulletin No. 802

REPUBLIC FLOW METERS CO.

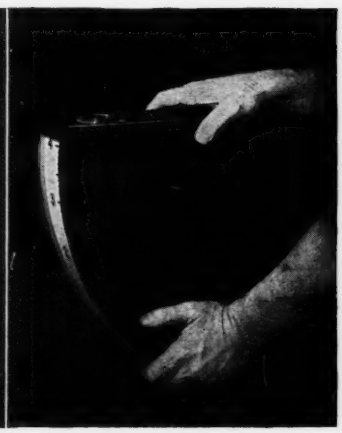
2224 DIVERSEY PKWY. **CHICAGO 47, ILLINOIS**



Supplied for either flush or projected mounting.

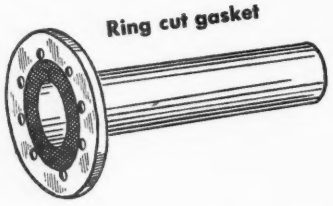


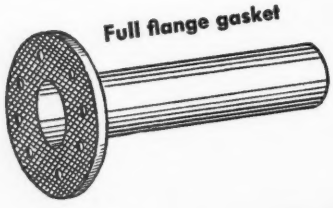
Any unit can be easily removed from the front without disturbing any other unit.



Each element is a complete, compact, sealed unit.

How to Seal Pipe Flanges...





A *ring cut* gasket, properly applied, does a better job than a *full flange* gasket. Here are a few hints that will help:

1. Make sure flanges are perfectly clean and true.

2. Use as thin a gasket as possible for the particular flange condition. (The rougher the flange surfaces, the thicker the gasket needed.)

3. See that the gasket is properly centered and does not project inside the flanges.

4. Pull up the flanges evenly and tightly, alternating from side to side to insure even pressure all around.

...and here's the Packing to do the job.

● You won't have to worry about pipe flanges if you seal them with J-M Service Sheet!

This has been proved by thousands of users over many years. That's why Service Sheet is today recognized as the No. 1 sheet packing for high pressure and high temperature conditions against super-heated steam, air, gas, water, hot oil, ammonia, acids, chemicals and many other fluids and gases.

To meet the increasingly severe demands of industry, Service Sheet has been constantly improved. Its dependability and high degree of uniformity are the result of quality and special manufacturing techniques developed in over 75 years of experience in the production of packings.

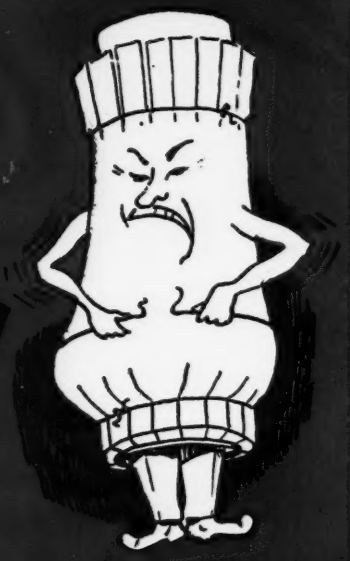
For further information about Service Sheet and other J-M Packings to meet specialized conditions, write Johns-Manville, 22 East 40th Street, New York 16, New York.

Johns-Manville

PACKINGS & GASKETS

THERE'S A DISTRIBUTOR NEAR YOU

TROUBLED BY "MIDDLE-AGE SPREAD"?

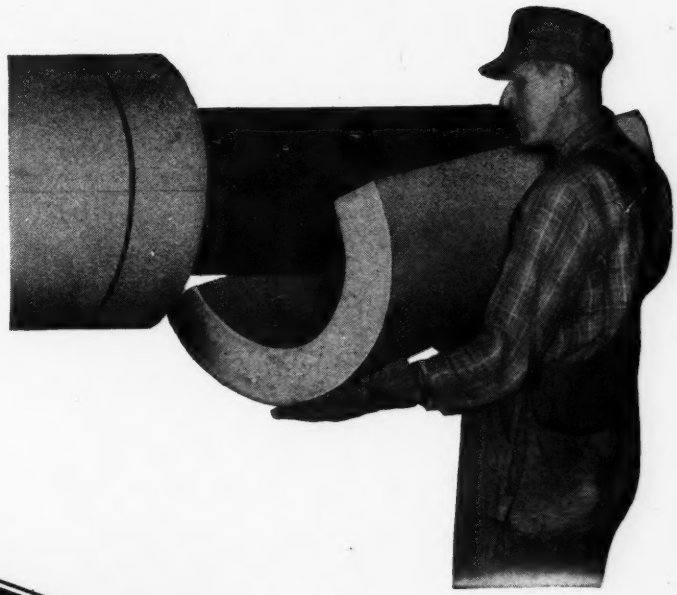


SIMPLY APPLY UNIBESTOS

it's simple to apply!

Unibestos, the sectional insulation, will not dent, shatter, sag or gap as the result of vibration, exposure to moisture or hard knocks. This greater structural strength is a result of Unibestos' resilient, tough fibrous construction.

Unibestos is available in half-section form up to 30" pipe diameter and in quarter sections from 32" to 60", in thicknesses from ¾" to 5". Single layer construction is available for service up to 1200°.



ARMY ARMY E NAVY NAVY

UNION ASBESTOS

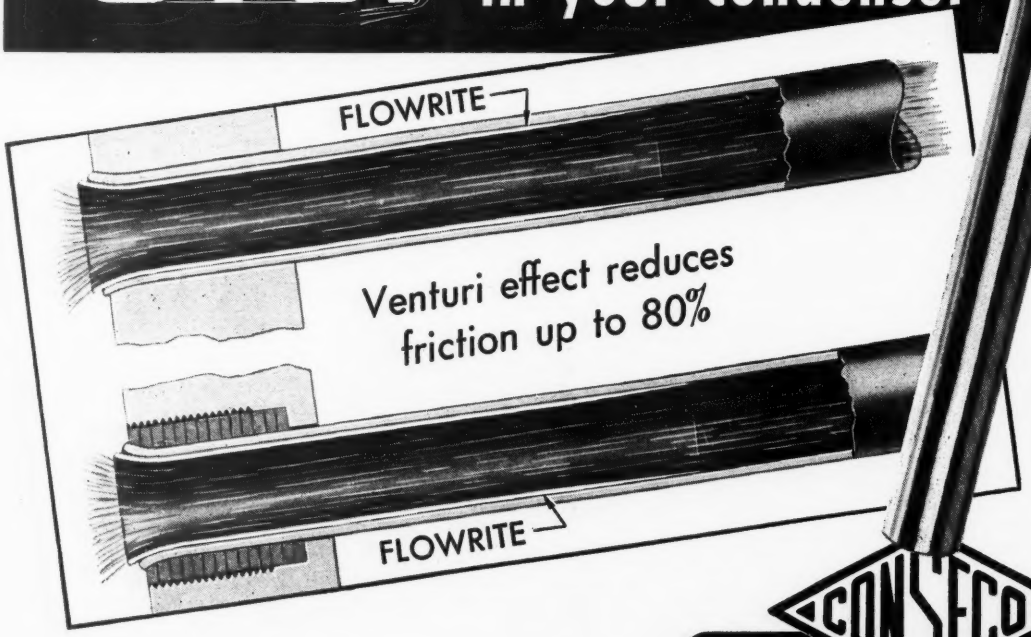
MEANS PROGRESS IN INSULATION

AND RUBBER CO.

COPYRIGHT
UNION ASBESTOS AND RUBBER CO.

PLANTS: 1821 S. 54th Ave., CICERO, ILL. • PATERSON, N. J. • BLUE ISLAND, ILL.
OFFICES: CHICAGO • CICERO, ILL. • NEW YORK • SAN FRANCISCO • PATERSON, N. J.

STOP TUBE EROSION in your condenser



CONSECO

FLOWRITES

Simple, inexpensive insurance against tube end erosion

Eliminate erosion of your condenser tube inlet ends by protecting them with Flowrites. Flowrites are short, belled-end inserts made of the same metal as the tubes themselves, which absorb the destructive effect of air and water turbulence at the entrance ends of tubes. Their peculiar shape provides a perfect entrance nozzle which reduces friction, and prevents liberation of gas bubbles which cause pinholes in the tube.

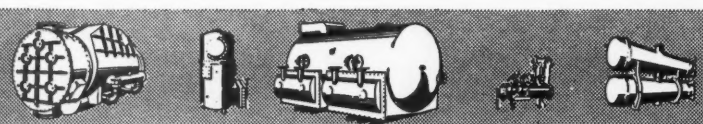
Flowrites virtually insure you against shutdowns from tube troubles. They are unbreakable, inexpensive to install in any type of tube joint, and easy to renew when worn. Flowrites are available in any length from 5½ in. to 26 in., to suit individual conditions. Why experiment with untried devices, when millions of Flowrites have been sold and used successfully for over 20 years. Write for details.

SEND TODAY

for our new bulletin, "Proof in Years and Numbers That FLOWRITES Prevent Tube End Erosion", giving Mass. Inst. of Technology test data and 24 year service record of Flowrites.

A highly skilled, specially equipped service organization, ready for immediate action anywhere on the continent, backed by engineering and manufacturing facilities producing over 3,000,000 sq. ft. of heat exchangers annually.

SERVICE CONDENSER SERVICE & ENGINEERING CO., INC.

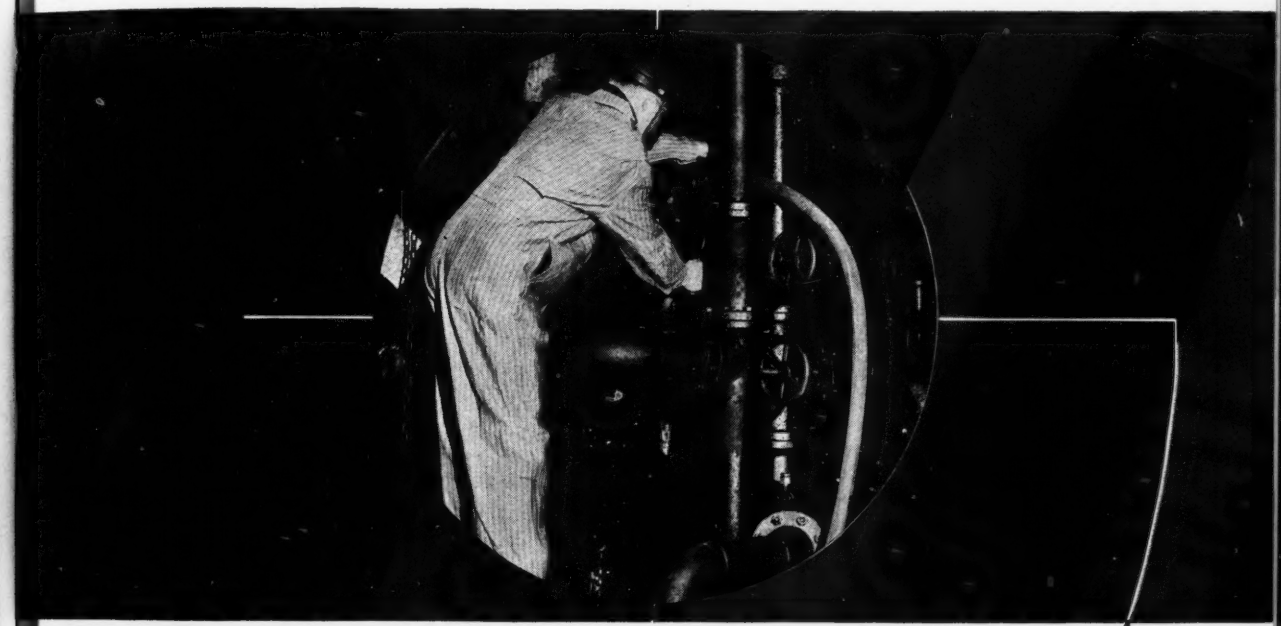


CONDENSERS • LOW PRESSURE EVAPORATORS • AIR EJECTORS • HEAT EXCHANGERS • PUMPS

TUBE CLEANING GUNS AND PLUGS
AIR AND EROSION ELIMINATORS
BEVEL GEAR UNIVERSAL JOINTS
STRAINERS, GREASE EXTRACTORS
WIZARD INJECTORS, FILTERS

DOWELL

CHEMICAL SCALE REMOVAL SERVICE



A JOB FOR ENGINEERS WHO KNOW YOUR PROBLEM

Look at the "before and after" pictures above and note the condition of the open box condenser tubes. This heat exchanger was returned to its original operating efficiency in a few hours because the proper solvent, reaching every part of the equipment, quickly dissolved and disintegrated the insulating deposits. Shut down time was further reduced as it was unnecessary to dismantle and reassemble the unit.

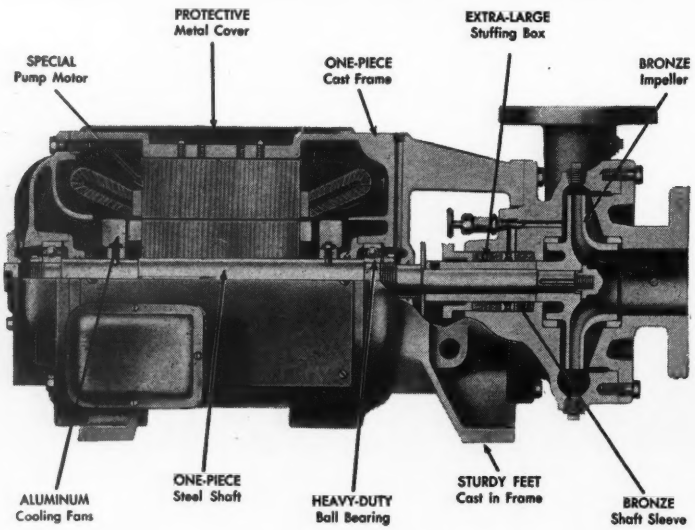
Back of every Dowell chemical treatment is careful study of the equipment, the metals involved and composition of the scale or sludge. Every Dowell engineer possesses knowledge based on years of experience and extensive technical resources.

Call the nearest Dowell office for information on how to restore your heat transfer equipment to efficient operation. Ask for a free estimate and your free copy of "More Power to America's Industry."

DOWELL INCORPORATED
Subsidiary of The Dow Chemical Company
Executive Office, Midland, Michigan
GENERAL OFFICE, TULSA 3, OKLAHOMA
New York • Philadelphia • Cleveland • Chicago • St. Louis • Houston
Kansas City • Wichita • Mt. Pleasant, Michigan • Salem, Illinois

X-Ray View

Shows Why A-C's Smooth-Running Electrifugal Pump is the Finest of its Kind!

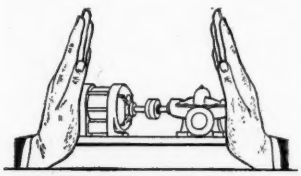


TOP QUALITY and extra value — that's what A-C's Electrifugal Pump gives you in terms of performance and economy! X-ray view above shows how Allis-Chalmers engineering has magically combined pump-and-motor into a single compact unit — which takes less space, gives you smooth operation with maximum protection against dangers of abnormal wear, leakage, corrosion, vibration! Consider these outstanding features: One-piece frame saves 33% in space; one shaft for pump-and-motor assures alignment; splash-proof motor is specially designed for pumping at low power cost. For further details on this great pump, call your nearby A-C office, or write ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN.

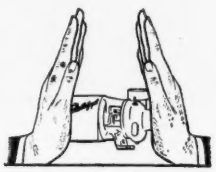
HEAR THE BOSTON SYMPHONY: *Saturday, American Broadcasting Co.*

A 1924

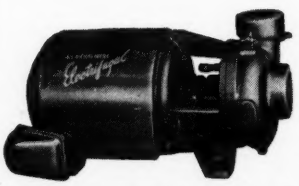
SQUEEZE PLAY CUTS SPACE 33%!



PROBLEM: Here is conventional pump and motor. How can we couple them together *better*—to save space, cut danger of misalignment, harmful vibration?



SOLUTION: We design a new kind of pumping unit—the one and only "Electrifugal" Pump! Motor and pump are now on one shaft—which cuts space 33%, assures alignment and smooth operation. No wonder "Electrifugals" give you more pumping power for your money!



SEA-BLUE BEAUTY: Modern design of Electrifugal Pump looks well on jobs anywhere! Capacities from 15 to 1600 gpm—heads up to 500 feet.

ALLIS-CHALMERS *Electrifugal* PUMPS

SIMPLEX VENTURI TUBES

the ULTIMATE IN *Venturi Efficiency*

For a given flow of water, the Simplex Venturi and its Simplex Meter will measure with the least loss of energy, and the greatest accuracy over the widest range of flow!

The high constant efficiency with which the Simplex Venturi utilizes the differential head which it creates, has been proved by over 40 years of research and manufacture.

This highly-engineered primary device assures minimum head loss and normal, dependable coefficients. The unit is homologous in type and form; the tube throat is bronze-lined with extremely accurate piezometer taps; the pressure belt type design is essential to high and unvarying accuracy.

The venturi tube is accepted as being the most efficient of primary devices. . . . Installations as part of pipes and conduits of cast material and of fabricated structure, have proved the Simplex Venturi to be unsurpassed in installed operating efficiency!

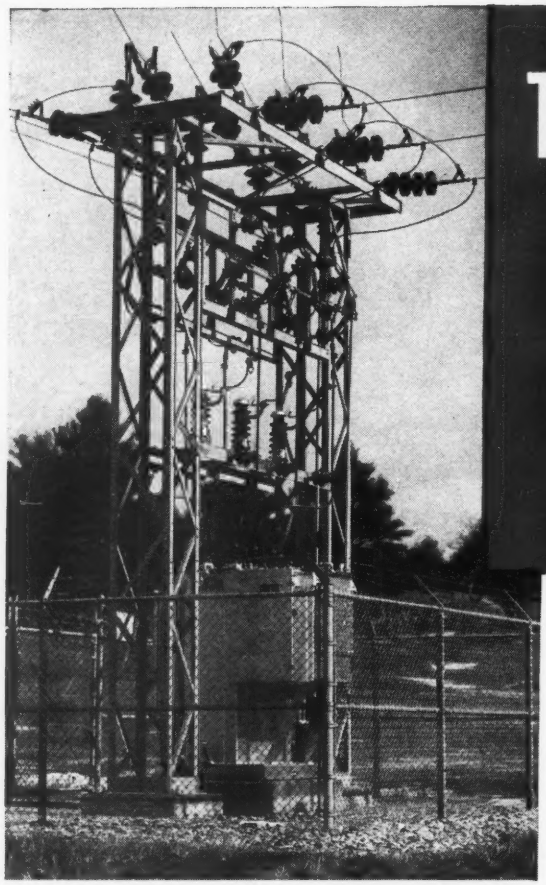
THE MO METER COMPLETES THE PICTURE

The "MO" is the "Master" Meter that converts the differential head created by the Simplex Venturi into rates of flow and indicates, records, and totalizes that flow with the maximum overall accuracy. This combination of Simplex primary device and MO Meter provides a standard of operating efficiency for the flow measurement of water, sewage and process liquids in many municipal and industrial plants. The MO Meter is of such high accuracy that it may be utilized for testing the accuracy of other metering equipment. Write for Bulletin 300 — "The Simplex MO Meter."

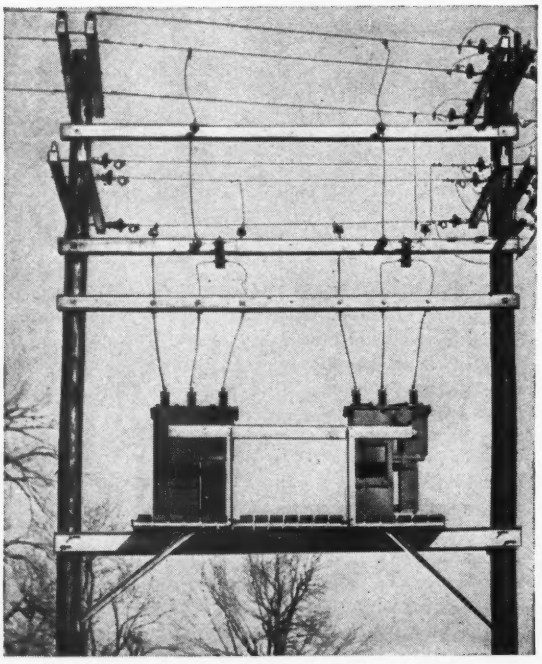
SIMPLEX VALVE & METER CO.
6783 UPLAND STREET, PHILADELPHIA 42, PENNA.

The RIGHT VOLTAGE at t

Here's every type of regulator you need, to have the right voltage—anywhere



STEP REGULATORS (MLT-32)—For urban and rural circuits 69,000 volts and below. Provide 10% regulation raise and lower in thirty-two 5/8% steps. Ratings 104 to 750 kva, three-phase.



BRANCH STEP REGULATORS (ML-4)—For very low-cost regulation; 10% raise or lower in four 2½% steps on 2400-, 4800-, and 6900-volt feeders. Up to 51.8 kva, single-phase.

● It is now easy and inexpensive to extend the benefits of good voltage to every point of your distribution system—or to every nook and corner of your plant. Whether you need voltage regulation for urban feeders, rural lines, factory circuits, or laboratory, there is a simple, economical G-E device for the job.

A few ways these devices may be able to help you:

ON PRIMARY CIRCUITS

1. As an aid in maintaining service standards and keeping customer good will in the face of wartime distribution problems. Also, to iron out feeder-voltage problems.

2. To find "hidden kilowatts" (by releasing extra system capacity) without revamping present lines or adding new feeders. They're a "natural" for voltage problems that must be solved quickly. They make possible more effective use of equipment already on a system.

3. To make your system capacity more adaptable for postwar loads. Sudden shifts in population, drops in wartime loads or increased domestic and commercial loads can be taken care of more easily—often without changing generator or transmission facilities.

4. To reduce system costs. Actual case histories show annual savings of from $834 to $9950 on a single feeder.

ON SECONDARY CIRCUITS

1. For improved lighting (more constant light level); for better starting of fluorescent lighting; for increased lamp life;—by holding voltage at the proper level.

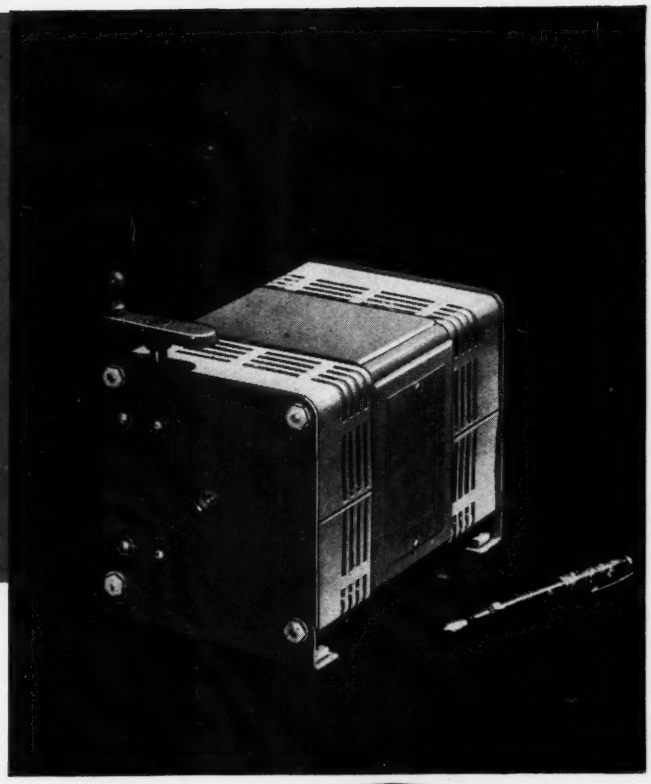
2. For greater production—by eliminating sluggish operation of motors and potential or control devices.

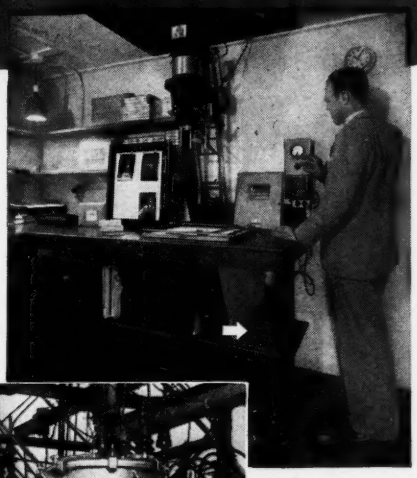
3. For longer life of electric equipment; for protection of precision electric devices, electronic tubes, etc;—by reducing overheating and burnouts.

4. For the right voltage in your laboratory to assure accurate test results in less time.

The regulators shown at work on these pages are only representative of the many G-E voltage-improvement devices that are available to help you. We shall be glad to help you analyze your voltage problem to determine what corrective measures are necessary. *General Electric Company, Schenectady 5, N. Y.*

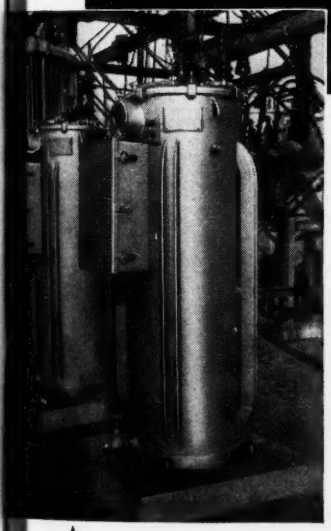
at the RIGHT PLACE Does the Job BETTER

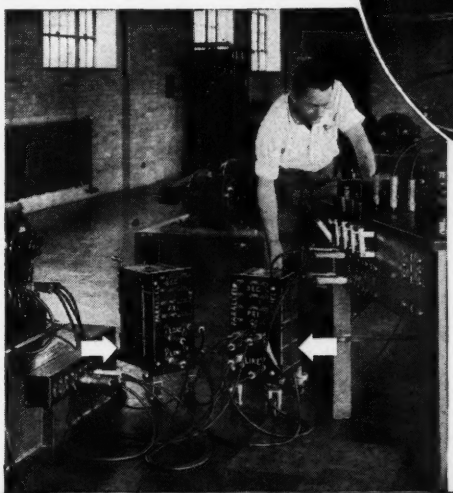




SMALL DRY-TYPE REGULATORS—For 120- and 240-volt circuits. 10% raise and lower or 100% raise and lower regulation. Up to 600 va, single-phase. 10% ratings available for automatic operation.

VOLTAGE STABILIZERS—Automatically provide a constant 115- or 230-volt supply to a given load, on circuits varying from 95 to 130 or 190 to 260 volts. Ratings from 50- to 5000-va output.





VARIABLE-VOLTAGE AUTOTRANSFORMERS — Provide smooth, adjustable control of voltage, current, light, temperature, power, and speed at a turn of the dial. Ratings from 243- to 810-va output for 115- and 230-volt circuits.

INDUCTION REGULATORS (IRS—oil-type or Pyranol for indoor or outdoor use)—Provide 10% regulation raise and lower on 2400-, 4800-, and 6900-volt feeders. 12 to 120 kva, single-phase. Also available three-phase.

DRY-TYPE REGULATORS (AIRS)—For secondary circuits. *Automatic type:* Provides 10% regulation raise and lower. *Remote-motor or hand-operated:* 100% raise and lower. Up to 12 kva, 600 volts, single-phase. Also available three-phase.

GENERAL ELECTRIC

The new boiler brought new problems

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THE CHANGE from 125-lb. boilers to a 600-lb. boiler brought varied problems to a major leather manufacturing plant.

Raw water supply was one of these, for the available water was contaminated and highly variable. This water was treated in a cold process softener employing various coagulants, including magnesium sulphate, then—still highly variable—went to a hot process softener for final softening. No filters were used.

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2. Planned the installation of an adequate oil removal system for the condensate, and recommended suitable coagulating chemical.

3. Taught the operating force to appreciate the need for exact and continuous control of conditions.

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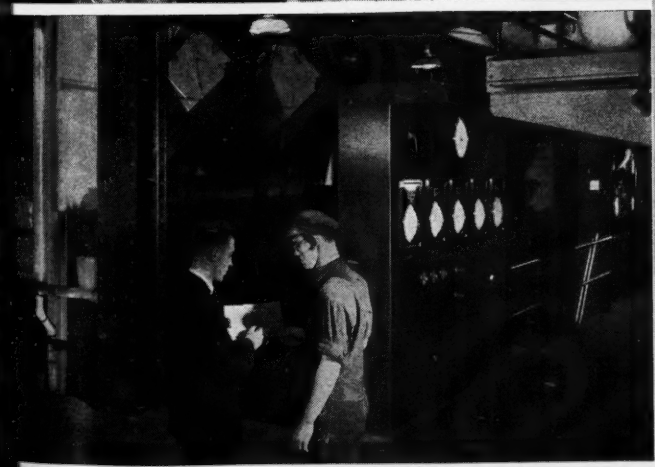

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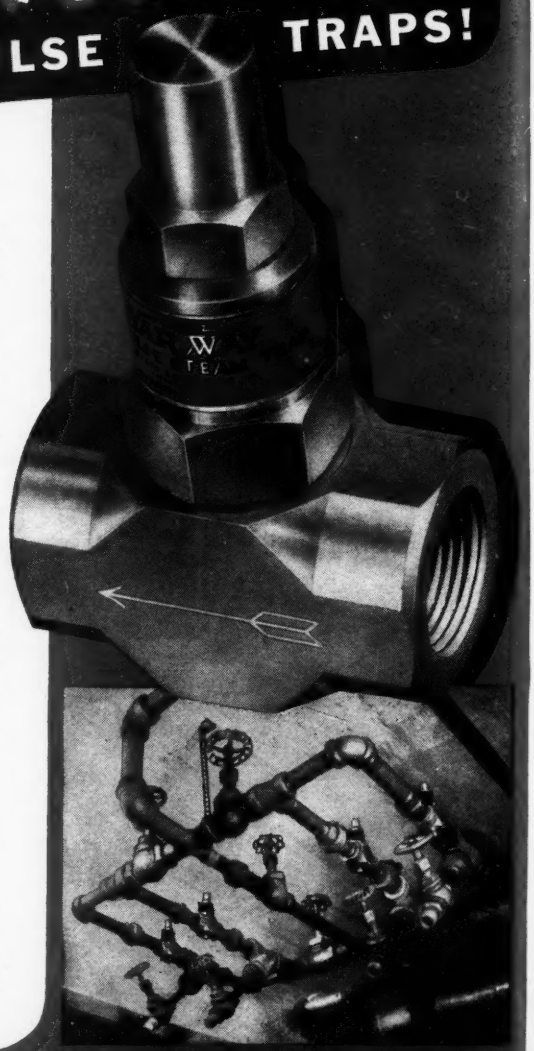

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YARWAY IMPULSE STEAM TRAP

WHAT LEADERS SAY

Industry to the Colleges

By M. M. BORING, A. R. STEVENSON, JR., and K. B. McEACHRON, JR.

M. M. Boring

A. R. Stevenson, Jr.

K. B. McEachron, Jr.

IN THE CONCERN of the nation for the problems of reconversion of industry there is often little recognition of the significant reconversion job which the colleges face. We are particularly aware of its importance and magnitude because of our close contact with college graduates and our interest in education generally.

Industry is rightly realizing the importance of education in engineering and welcomes an opportunity to discharge a part of its responsibility in this field by co-operating with the colleges in studying postwar curricula.

The Accelerated Schedule. There is grave danger that some colleges and the public generally may believe that an accelerated college program is superior to the prewar college schedule. Experience with those graduates employed in the last two years leads us to believe that the engineering graduate of an accelerated program is limited, compared with his prewar predecessor, in his ability to analyze engineering problems from fundamentals.

Those who advocate continuing the accelerated program fail to recognize the loss to the national culture and the lack of all-round ability of engineering graduates under such a program.

Except for men returning from the services, a negligible number of engineers will be available to industry in the next few years. Nothing should delay an immediate return to regular college programs in order that this barren period may be as brief as humanly possible. Any changes that are to be made, therefore, must not delay this return.

Basic Engineering Fundamentals. Engineering education in college must be concerned with engineering fundamentals rather than specialized design. The war has shown us that radically new designs must usually be based on the fundamentals of engineering rather than on previous design. It is far more important, therefore, for the college graduate to have thorough understanding of all the fundamentals underlying engineering rather than detailed knowledge of any specific design or device. For example, a thorough understanding of such fundamentals as Newton's laws is of far more value in the solution of general mechanics problems than a host of specialized formulas.

Many will take exception to these beliefs, pointing out that widespread acceptance of them would lead to a single unified undergraduate engineering curriculum. At least one educational institution has done exactly that with success. In the authors' company, little recognition is ever taken of the branch of engineering in which a person was graduated, as the requirements of any electrical manufacturer so combine the mechanical, electrical, and chemical fields as to be almost inseparable.

The Case for Specialization. It has been argued in the past that the colleges must provide specialized training rather than fundamental understanding because many small companies do not have educational programs which will assist the graduate in obtaining practical experience. It is our belief that it is no more practical to graduate full-fledged engineers from college than practicing doctors from medical school. Perhaps because the materials with with which the doctor deals are irreplaceable, we have recognized the importance of interneship earlier in

(Continued on page 126)

The authors are all on the staff of General Electric Co. Mr. Boring, a graduate of the University of Colorado—B. S. in electrical engineering—has been connected since 1922 with the recruiting, training and placement of student engineers for GE. He joined GE in 1916, transferred to the Motor Department in 1919 and was made assistant foreman in that department in 1920.

Dr. Stevenson is a real GE phenomenon, a native of Schenectady, growing up there as the city developed an "electrical consciousness." He was graduated from Princeton University with a CE degree; after service in World War I, received MS and PhD degrees from Union College; joined GE in 1917. He served in various technical capacities in the U. S. Air Service at Langley Field and Paris, France until 1919 when he re-entered the GE industrial engineering department. Since 1923 he has been a member of the engineering general department. One of his principal jobs was to assist R. E. Doherty in setting up the company's advanced course in engineering, considered one of the company's most valuable activities. It still lies closest to his interests. His work in refrigeration and air conditioning is also well known.

Dr. McEachron was graduated from Ohio Northern University, also from Purdue University as MS in electrical engineering, later receiving degrees of Dr Eng from the fomer and DSc from the latter. He joined GE in 1913, was instructor in electrical engineering, research associate at Purdue 1918 to 1922, was in charge of research and development section, lighting arrestor department, 1922. From 1933 to date he has been research engineer of high voltage practice in charge of the Pittsfield high-voltage laboratory. He is largely responsible for Thyrite, has written "Playing with Lighting" and other works and was AIEE vice-president in 1933.

The above is abstracted by permission from a paper published in the April, 1945, issue of the Journal of Engineering Education and in the August, 1945, issue of Mechanical Engineering.

Modernization of Power Plant Produces High Fuel Savings

The installation of a new 2500-kw turbogenerator at the Rossford, Ohio, plant of Libbey-Owens-Ford Glass Company, together with other improvements is expected to result in a fuel savings of at least 7000 tons of coal. The modernization project involves no new boiler nor new condenser. The new generating unit is placed over an old condenser which formerly served a 40 cycle unit which was removed and sold for scrap.

By W. E. Hopkins — *Mechanical Division, Stone & Webster Engineering Corporation*

THE EXISTING POWER plant of Libbey-Owens-Ford Glass Company at Rossford, Ohio, is an isolated station and generates all of the factory electric power, steam and compressed air requirements. It was initially constructed many years ago by The Edward Ford Plate Glass Company and has been progressively modernized and enlarged.

Over a period of years, the early boilers have been replaced with four 420 lb boilers having a total steam generating capacity of 375,000 lb per hour. The existing electric generating equipment consists of one 6,000 kw, 6,900 v, modern 60 cycle condensing unit with provision for extracting 5 lb steam for feed water heating and four very old 2,000 kw, 560 v, 40 cycle straight condensing units. Two frequency changers with combined capacity of 6,000 kw permit power generated at 40 cycles to be fed to the 60 cycle system since the present 60 cycle factory load exceeds 9,000 kw and the 40 cycle demand has been reduced to below 500 kw.

Two steam engine driven 3,650 cfm air compressors were installed in 1939 to exhaust into the surface condenser that formerly served a 2,000 kw, 40 cycle turbine generator which was judged in 1938 to be unfit for further service. This condenser will now serve the new 2,500 kw turbine, resulting in the necessity of providing new condensing equipment for the air compressor engines.

Engineering studies begun in 1939 indicated that aside from the need for additional generating capacity to insure continuity of factory production in case of forced outage of 60 cycle generating unit installed in the plant, addition of a new 60 cycle turbine generator would be justified by annual savings in coal consumption amounting to over 7,000 tons which should result for the following reasons:

(a) Reduction in load on the frequency changers. Electrical losses in this equipment amount to about 20 per cent.

(b) Generation of power by steam

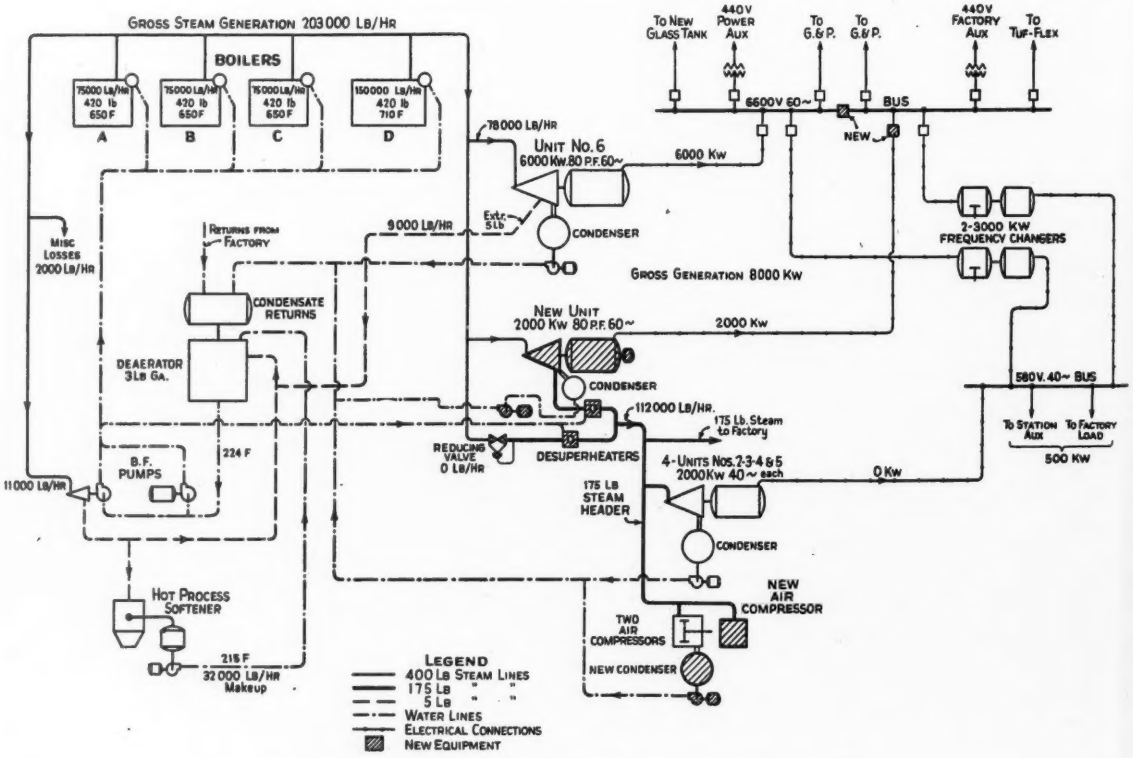


Fig. 1. Flow Diagram, Rossford plant, Libbey-Owens-Ford Glass Company

entering new turbine at 400 psi and being extracted at 185 psi for use by factory process, 40 cycle units or air compressor engines. This steam is now produced at 400 psi and passes through a pressure reducing valve to the factory process system.

A program for improving the existing power plant was planned in 1940 but was deferred because of wartime shortage of power plant equipment. In 1941 a 2,000 kw extraction condensing turbine generator was purchased from the Elliott Company and was partially fabricated before the project was halted in 1942. The project was reinstated by the War Production Board, late in 1944, on account of the exceptionally high fuel savings in proportion to the quantities of critical materials and construction labor required for the installation.

During the wartime period that the project was suspended, increases occurred in the factory steam and electric power requirements which made it desirable to install a larger machine. After investigation it was found that because of the conservative design used, only minor alterations were required to increase the capacity rating of the turbine generator unit from 2,000 to 2,500 kw, and to increase the extraction flow from 100,000 to 120,000 lb per hour. The higher temperature rises that will occur in the generator remain within the limitations of ASA and NEMA standards.

The turbine will receive steam at 400 lb per sq in. and 750 F. Steam will be extracted at 185 lb per sq in. and 620 F and will be supplied to the factory in parallel with an existing 400/185 lb pressure reducing and desuperheating station that is being revamped for close control as stand-by apparatus. It will be necessary to desuperheat the extraction steam from 620 to 485 F to avoid overheating process vessels. All of the pressure reducing and desuperheating equipment, including a small unit for turbine washing, is being furnished by The Swartwout Company. A vertical Ingersoll-Rand high pressure pump is being installed to supply condensate for desuperheating purposes.

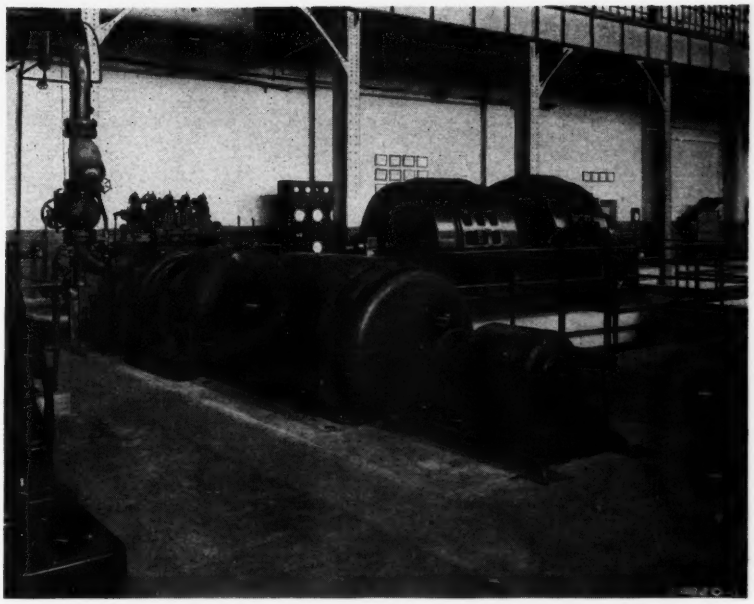


Fig. 3. The new 2000 kw generating unit with the two 3000 kw frequency changers in the background

No New Boiler Needed

No new boiler equipment is required and no new building is needed since the turbine has been placed over an existing surface condenser on a foundation formerly used by an old 2,000 kw, 40 cycle unit which has been removed and sold for scrap metal. The condenser was relaned to improve the vacuum available at the turbine exhaust and new two-stage air ejector equipment was installed. A new and smaller condensate pump driven by an alternating current motor will be in normal use with the larger existing condensate pump driven by a direct current motor held in reserve as stand-by equipment.

The new turbine generator is equipped with a generator air cooler and an oil cooler for which new circulating water piping will be required. An instrument gage board is provided on the turbine room operating floor. All flow and temperature recorders are being furnished by the Bailey Meter Company.

The general arrangement of the new and existing equipment is indicated by the flow diagram designated Figure 1.

Fig. 2. General view of the turbine room at the Rossford plant of the Libbey-Owens-Ford Glass Co.

Switchgear Has Been Extended

In connection with the installation of the new generator, the existing 6,900 v truck type switchgear has been extended to provide additional feeder capacity to the factory. The bus has been sectionalized and one generator is connected to each of the two bus sections. Feeder circuits have been balanced as nearly as possible on the bus sections which normally operate in parallel.

Both 60 cycle generators have been equipped with General Electric Company type GDA direct acting voltage regulators.

Expansion of the glass manufacturing facilities made it necessary to install the third air compressor which

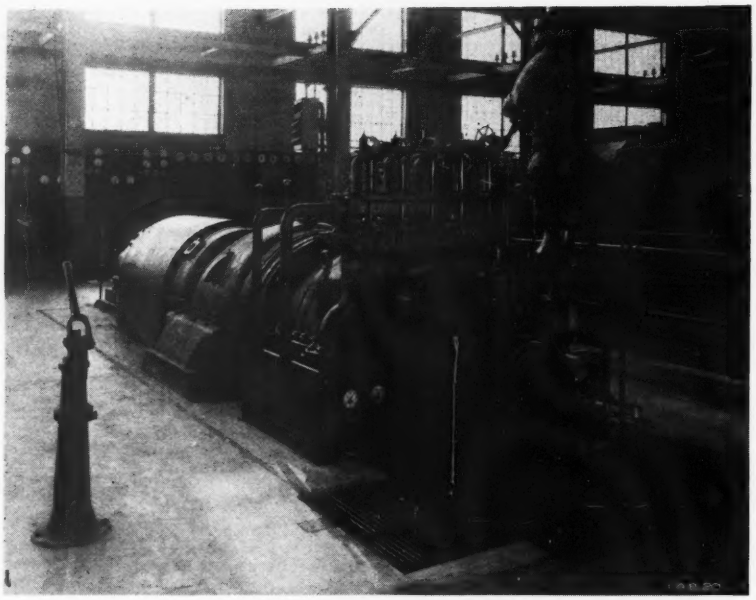


Fig. 4. Showing the steam end of the new generating unit

will duplicate two existing compressors installed in 1939.

The new air compressor is a Worthington, cross compound, two-stage, steam engine driven unit having a capacity of 3,650-cfm of free air at 100 lb per sq in. gage. The engines take steam at 175 lb per sq in. gage and 480 F, and will exhaust at about 26 in. Hg. A new 1,760 sq ft, single pass, Foster-Wheeler, surface condenser was provided to receive the exhaust from the two existing compressor engines, as well as the new third unit. The condenser has been equipped with a two-stage air ejector and a single motor driven condensate pump.

The basic studies underlying this installation as well as the final design and construction were conducted by Stone & Webster Engineering Corporation under the direction of Mr. D. H. Goodwillie, Executive Vice President, Mr. C. L. Drake, Director of Engineering and Mr. W. H. Hasselbach, Chief Engineer of the Libbey-Owens-Ford Glass Company.

New Power Plant for Standard's Baton Rouge Refinery

Part II

HAVING IN MIND the description of the functioning of the principal elements of this plant given in Part I of this article in the September issue, let us now consider the effects of operating variations on these elements and, in turn, of the operation of the various elements on the heat balance.

Heat Balance

The first stage of the water treatment process, clarification, is conducted before the water is heated, and has no significance so far as the heat balance is concerned. The second stage includes deaeration and sludge precipitation and removal after the water has been heated from 200 to 250 F and for heat balance purposes the hot process softeners may be considered as deaerating heaters. Feedwater heating, as illustrated in Fig. 6*, consists of passing feedwater through a number of heat exchange elements in series and the influence of these will be discussed. For heat balance discussion, the first three of these:—generator oil cooler, generator air cooler and condensate cooler—may be considered together.

Generator Air and Oil Coolers and Condensate Cooler

These three exchangers have very little effect on the heat balance, as the various charts indicate. The maximum temperature rise in the feedwater to the low pressure blowdown exchanger due to the presence of these three exchangers in the circuit will in all cases be less than 10 F, even at reduced boiler outputs. The effect of these three items is merely to increase the entering river water temperature to the remaining principal heat exchangers slightly.

The heat added to the feedwater by the generator oil coolers will be constant regardless of turbine load.

The heat added to the feedwater by the generator air coolers will vary with generator output and power factor but is small in quantity compared with the total amount of feedwater passing through the air coolers and the temperature controlled by-pass around the circuit containing these three heat exchangers.

The heat added by the condensate cooler is relatively constant regardless of turbine load and boiler output,

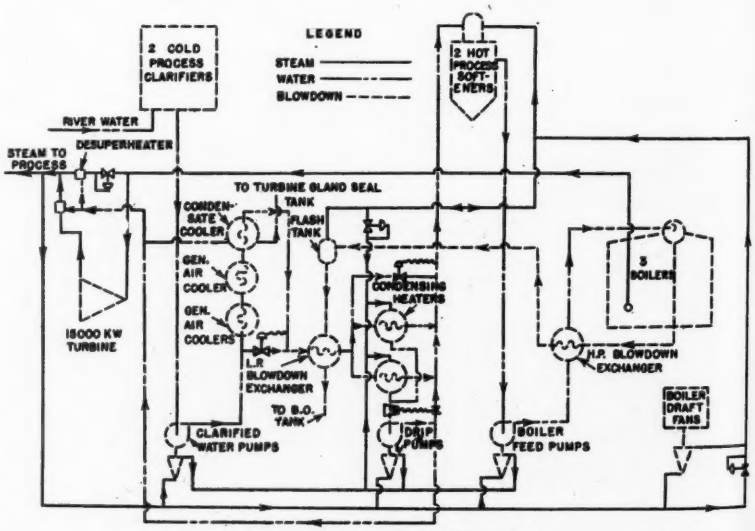


Fig. 6. Basic flow diagram of SPLA plant

*Repeated from page 90, September, 1945 issue.

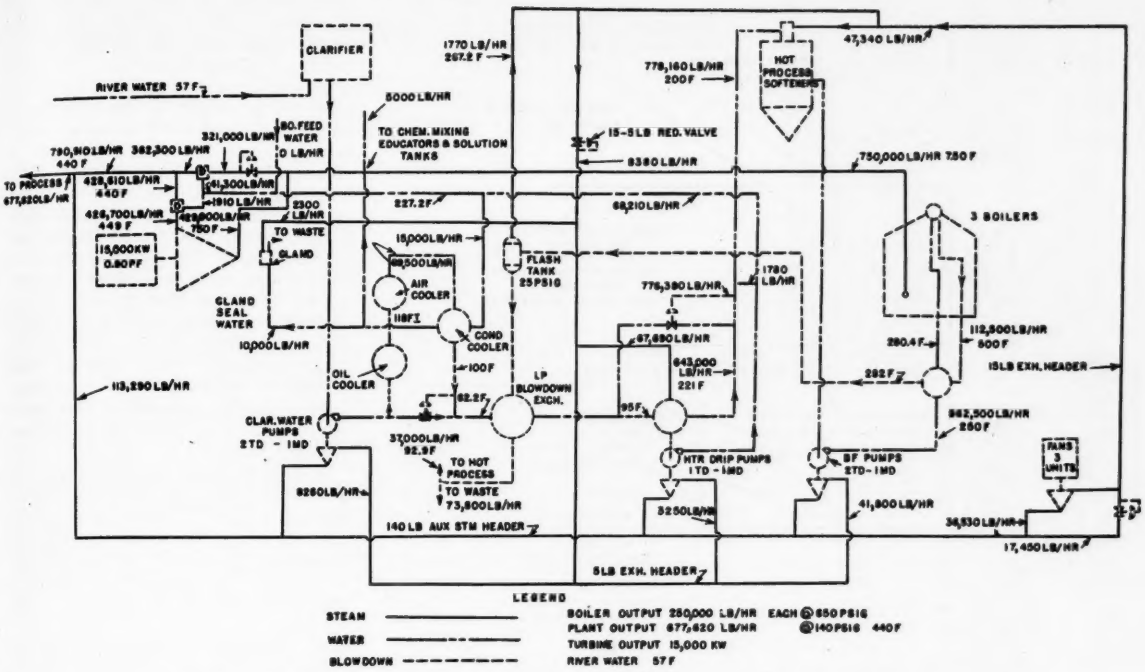


Fig. 7. Heat balance diagram of SPLA plant for process steam output of 677,620 lb per hr

as turbine gland seal water requirements are constant regardless of output and the cooled condensate requirements for chemical mixing are expected to be relatively constant in operation, while the condensate temperature to the exchanger remains unchanged at all loads. As feedwater flow through these three exchangers is regulated to maintain 100 F at the condensate cooler outlet, with the balance of the feedwater by-passed, the variation in heat picked up in the generator air coolers will affect the cooled condensate temperature slightly but this variation will be so small as to be of no importance.

Low Pressure Blowdown Exchanger

The temperature rise through the low pressure blowdown exchanger will not vary very greatly with feedwater flow as the ratio between blowdown quantity and feedwater quantity is expected to remain relatively fixed once the optimum is established for all boiler outputs. A comparison of corresponding figures on heat balance charts for four load conditions shows a temperature rise variation through this exchanger from 22.3 F to 30.5, which is not a large variation. What variation occurs is caused by variations in feed water temperature to the exchanger, (dependent principally on river water temperature) and blowdown water temperature from the boiler steam drums (which varies slightly with boiler output due to changes in superheater steam pressure drop). The steam drum pressure variation effect on blowdown water temperature will be largely ironed out before the blowdown reaches the low pressure exchanger, due to previous blowdown passage through the high pressure blowdown exchanger and the flask tank.

Condensing Heaters

As will be seen from Fig. 6, feedwater flow through condensing heater by-pass line is automatically regulated by a temperature control valve to maintain 200 F feedwater temperature to the hot process softener. As the feedwater temperature to the condensing heater and associated temperature control by-pass line varies almost directly with river water temperature, while the outlet temperature from the circuit is fixed at 200 F, the amount of steam which can be condensed by these condensers will vary with river water temperature. On the other hand, the steam to be condensed, coming from all the auxiliary turbine-driven pumps in the station, plus a small amount from the gland leak-off on the main unit, will vary independently of river water temperature. Therefore, with high river water temperature, when the condenser capacity will be low, there will be an excess of 5-lb. exhaust steam from steam driven pumps unless some or all of the motor drives are substituted.

For this reason, some of the pumps will operate with motor drives. As the boiler feed pumps are by far the largest producers of 5-lb exhaust steam for these condensers, the effect of running one turbine-driven pump where possible, instead of two, will have a very great effect upon the amount of exhaust steam to be condensed. Any deficiency of 5-lb exhaust steam is automatically made up by the reducing valve connecting the 15 and 5-lb exhaust headers. Any excess of 5-lb exhaust steam is discharged to atmosphere through safety valves.

Since all turbine drives for the various pumps have some margin in horsepower and are provided with hand valves to improve water rates at loads less than 100 per cent, it will be advisable to adjust hand valves carefully at full pump output to reduce the amount of exhaust steam to a minimum, thus permitting operation with auxiliary turbine drives only at the maximum possible river water temperature.

Figure 8, which is diagrammatic only, serves to illustrate some of the points in the above discussion.

Hot Process Softeners (Deaerating Heaters)

As will be seen from the diagram Fig. 7 and from the above discussion, the feedwater is heated from 200 F to 250 F in the hot process softeners. The 15-lb steam for this heating is supplied from the boiler draft fan turbine exhausts, with any deficiency made up by a reducing valve connecting the 140-lb auxiliary steam supply header with the 15-lb exhaust header. As the fans are of liberal size to allow for boiler fouling and contingencies and as the fan drive turbine size contains some margin over the maximum fan horsepower required the maximum turbine horsepower is considerably in excess of the anticipated maximum horsepower requirements of the fans under normal conditions of operation. For this reason, these turbines are provided with four hand valves each to provide maximum economy at partial loads.

The feedwater temperature is raised only 50 F in absorbing this fan exhaust, hence the amount of steam which can be absorbed is limited. For

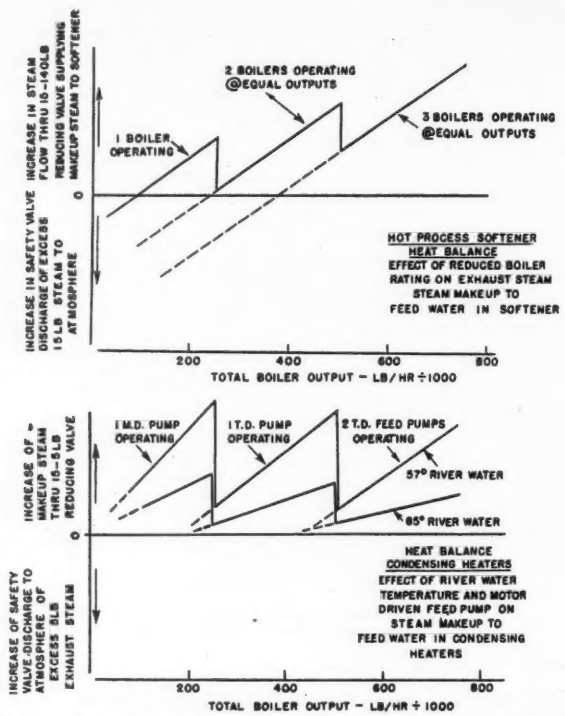

INCREASE IN STEAM FLOW THRU 10-14 LB REDUCING VALVE SUPPLYING MAKEUP STEAM TO SOFTENER
INCREASE IN SAFETY VALVE DISCHARGE OF EXCESS 15 LB STEAM TO ATMOSPHERE
2 BOILERS OPERATING @EQUAL OUTPUTS
3 BOILERS OPERATING @EQUAL OUTPUTS
1 BOILER OPERATING
HOT PROCESS SOFTENER HEAT BALANCE
EFFECT OF REDUCED BOILER RATING ON EXHAUST STEAM STEAM MAKEUP TO FEED WATER IN SOFTENER
200
400
600
800
TOTAL BOILER OUTPUT - LB/HR ÷ 1000
INCREASE OF MAKEUP STEAM THRU 10-15 LB REDUCING VALVE
INCREASE OF SAFETY VALVE DISCHARGE TO ATMOSPHERE OF EXCESS 15 LB EXHAUST STEAM
1 M.D. PUMP OPERATING
1 T.D. PUMP OPERATING
2 T.D. FEED PUMPS OPERATING
57° RIVER WATER
85° RIVER WATER
HEAT BALANCE CONDENSING HEATERS
EFFECT OF RIVER WATER TEMPERATURE AND MOTOR DRIVEN FEED PUMP ON STEAM MAKEUP TO FEED WATER IN CONDENSING HEATERS
200
400
600
800
TOTAL BOILER OUTPUT - LB/HR ÷ 1000

Fig. 8. Heat balance diagrams for hot process softeners and condensing heaters, SPLA plant

this reason, the combustion control fan speed control valve should be carefully adjusted to give maximum fan efficiency and the minimum amount of supplementary fan damper control; and as many of the hand valves as possible should be on each turbine closed to give maximum turbine economy. It is anticipated that full load on a clean boiler may be carried with all four hand valves on the fan turbine closed.

In spite of the careful adjustments outlined above, if the boilers are all operated together at very much reduced loads, an excess of draft fan exhaust steam will be inevitable. This condition would be remedied, however, if the steam load were carried on fewer boilers operating at higher output.

If advisable, the setting of the feedwater by-pass control valve around the condensing heaters may be set down from 200 F to 190 F to provide greater heat absorbing capacity for fan turbine exhaust steam in the hot process tanks.

This procedure, however, will reduce the capacity of the condensing heaters to absorb 5-lb exhaust steam from the turbine driven pumps and will necessitate switching from turbine to motor pump drives at a lower river water temperature. The optimum setting of this condenser by-pass control valve will be determined from operating experience. At the low boiler outputs realized during preliminary operation with the attendant low feedwater flows, some discharge of 15-lb fan turbine exhaust steam is to be expected.

High Pressure Blowdown Exchanger

In general the remarks applying to the performance of the low pressure blowdown exchanger apply with equal force to this exchanger. The temperature rise of the feedwater is practically constant regardless of feedwater flow or river water temperature. Since feedwater temperature to this exchanger is constant, the resulting water temperature to the boilers is practically constant at all flows for equal blowdown-to-feedwater quantity ratios.

Effect of Main Unit on Heat Balance

Whether or not the main turbine generator unit is operating has very little effect on the heat balance of the station. The slight effects to be expected with main unit operating are:

1. Slight heating of the feedwater previous to entering the low pressure blowdown exchanger as previously discussed.

2. An increase of 10,000 lb per hr in the demand for condensate (for gland seal) thus reducing the amount of condensate returned by the drip pumps to the feedwater line to the hot process softener.

3. A reduction in the amount of condensate required for desuperheating the steam to process, having some secondary result as in (2), but in reverse.

4. A slight decrease in process steam flow coincident with the reduction in desuperheating water.

Condensate Supply

Heat balance for some loads and high river water temperatures show a deficiency of condensate for desuperheating, necessitating make-up of desuperheating water from the boiler feed discharge header to the extent of 11,620 lb per hr. This condition will arise when high feedwater inlet temperature to the condensing heaters (caused by high river water temperature) limits the amount of steam which can be condensed in the condensers, thus limiting the production of condensate. If the boiler plant is operating at full load with the turbine in service, the excess steam from the boilers, over and above that required by the turbine, requires a considerable precentage of desuperheating water after passing through the main reducing valve system. This condition overloads the condensate system causing automatic addition of boiler feedwater to the main desuperheaters.

It is undesirable to use boiler feedwater for desuperheating purposes except in cases of emergency, as the character of the water, in spite of treatment, is such that considerable solids will be introduced into the steam leaving the station this way. This in time, would adversely affect heat exchange apparatus in the refinery and the station auxiliaries. In practice, the supply of condensate may be augmented by partially bypassing the feedwater around the low pressure blowdown exchanger, thus cutting down its efficiency, lowering the feedwater inlet temperature to the condensing heaters, and thus increasing their capacity for condensate production.

With the turbine out of service and all boiler plant output passing through the main reducing valves and desuperheaters, the condensate required for desuperheating will be at a maximum, thus requiring operation as outlined above if river water temperature is high. The condensate demand, however, will be reduced to the extent of 10,000 lb per hr when the turbine is out of service by the shutting down of the turbine gland seal water supply system.

Heat balances all show condensate flow of 5000 lb per hr to the water treating plant for chemical mixing. The water treating plant operators should fully understand that the withdrawal of condensate from the power plant for chemical mixing should be as steady as possible to prevent momentary overloading of the condensate system.

Acknowledgments

For the most cordial co-operation in making available the data on the SPLA plant given above, we are indebted to the Louisiana Division, Standard Oil Company of New Jersey and to Stone & Webster Engineering Corp. Technical data were furnished through the co-operation of W. F. Ryan, assistant engineering manager of the Stone & Webster organization. T. A. Fearnside was the Stone & Webster engineer in charge of the design of the SPLA power plant.

Steam Turbine Repaired by Metallizing

By **HENRY M. ATWOOD** Field Engineer, Metallizing Co. of America

FOR OVER A PERIOD of 23 years, a steam turbine installed in 1919 in the power house of a New England branch plant of one of the country's largest producers of metals, had been suffering from progressive erosion of the housing from wet steam. Upon the inspection, it was suggested that metallizing could be employed to salvage this equipment.

On the sections of this job where the rebuilding of strength or of original dimensions was not a factor, a coating of No. 1 (18-8) stainless steel sprayed to a thickness of approximately 0.025 was recommended. Due to the design of this turbine, the erosion which had taken place had not in any way affected the efficiency of the machine. Therefore, it was not necessary to restore the original dimensions and the recommended coating of 0.025 in. thickness will arrest any further deterioration for the remaining life of the other parts of the machine.

In order not to mar the finish of the channels in which the diaphragms are held, masks made of wood sections and covered with sheet rubber packing were made and fitted tightly in place as illustrated clearly in Fig. 2. The upper half of the turbine was treated first. A round frame work was erected around it to carry tarpaulins in the form of a tent to prevent the steel grit used in cleaning and roughening the sections to be sprayed from flying, and to prevent the scale and dust blasted out of the housing from getting into surrounding machinery. The blasting operation was carried out one section at a time and the spray applied immediately after each section was blasted.

Figure 3 illustrates the means of mounting the metallizing gun in order to relieve the operator of the strain of holding the gun during the spraying process and also to insure an absolutely uniform thickness of coating on all treated surfaces. An angle iron was bolted across the casing and a length of pipe welded at right angles to the bottom of the angle iron. A short length shaft was inserted in this pipe and the end of the shaft drilled for a rod which was locked in position by a set screw. The metallizing gun was mounted at one end by means of the tool post mounting and a counter weight welded to the other end of this rod.

Figure 4 shows the completed upper half of the casing. The areas treated with steel grit may be easily distinguished by the light gray appearance of the stainless steel. After the machine has been in service for some time, the action of the steam and water thrown off by the rotor will automatically polish away the matte surface of the stainless steel and present a bright, tough, non-corrosive surface which will resist attack for many years.

Fig. 1. Copper plate shown at right center inserted to receive sprayed metal. Drive screws set in to strengthen eroded rib. Before spraying, heads of screws were cut away

The estimated cost of the job was as follows:

50 lb of stainless steel metallizing wire at 70c a lb	$35.00
800 lb of steel grit at 6½c a lb. (This grit may be used many times for other purposes)	52.00
Labor—two men, 45 hr each at $1.00 per hr	90.00
2 cylinders of oxygen at $4.00	8.00
1½ cylinders of acetylene at $6.00	9.00
Miscellaneous materials — lumber, rubber sheeting, etc.	20.00
	$214.00

Thus, by metallizing, a piece of equipment costing over $60,000 and not replaceable under present conditions has been restored to service at a cost of less than $215.00.

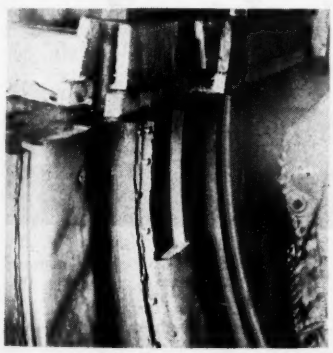


Fig. 2. Eroded rib damaged to average depth of 5/8 in.

Fig. 3. Jig devised to aid operator in holding metallizing gun

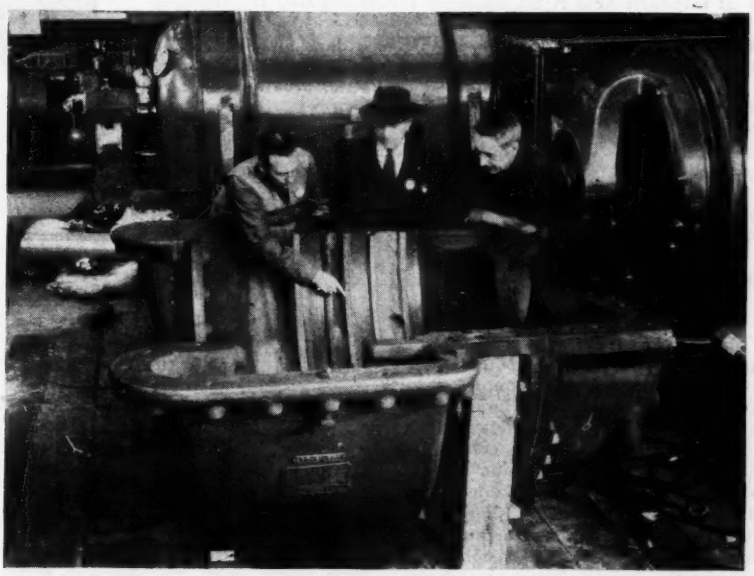


Fig. 4. Area of turbine casing built up 0.025 in. using 18-8 stainless steel

How to Test Water in the Boiler Room

A Review by

E. O. Davis

Photographs by **The Permutit Company**

Step-by-step directions for making the standard tests on feedwater and boiler water in plants operating at 200 psi or less . . . With a few dollars' worth of burettes, beakers, bottles and chemical reagents, you can improve operation of boilers and auxiliaries, prevent scale and carryover . . . If you have outside water treatment counsel, your own test knowledge will help you carry out their recommendations more effectively.

Here's the Equipment You'll Need →

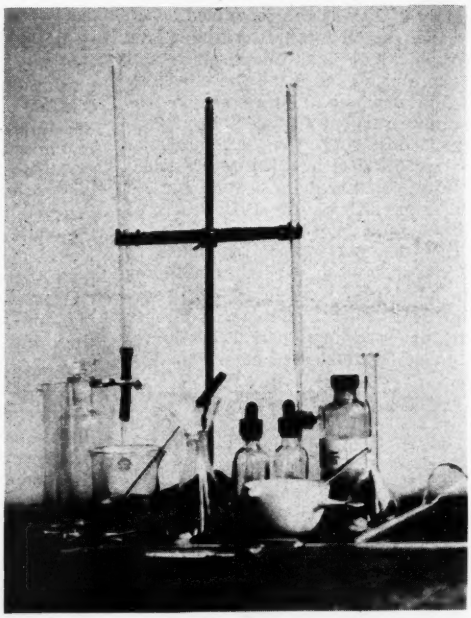
For about $10 you can assemble from standard laboratory equipment a test kit like the author's at the right. For $20 you can purchase a complete kit with automatic burettes.

Whether the graduates, burettes, etc., are marked in ml (milli-liters) or cc (cubic centimeters) the results will be the same, because 1 ml = 1 cc.

2—Burettes 10cc, subdivided 0.1 cc with pinch cock (for silver nitrate and N/7 sodium hydroxide).
1—Burette 10 cc, subdivided 0.1 cc with stopcock (for soap solution)
1—Burette 25 cc, subdivided 0.1 cc with stopcock (for N/50 sulphuric acid)
1—Cylinder Graduate, marked 58.3—50—29.15—14.57 cc.
1—Cylinder Graduate, marked 10 cc, for benzidine hydrochloride.
1—Pipette, 25 cc, for sulphate test. 1—250-cc beaker.
1—250-cc Erlenmeyer flask with rubber stopper.
2—150-cc porcelain casseroles. 2—15-cm glass stirring rods.
1—5-cm funnel, 10 cm stem. 1—10-cm funnel, 10 cm stem.
1—8-oz. oil bottle, with glass stopper.
100 sheets 10-cm filter paper. 100 sheets 20-cm filter paper.
1 qt pail for each sample collected.

Reagents

1 qt sulphuric acid N/50, meaning 1/50th normal, the strength of the acid.
1 qt silver nitrate N/58.3 (keep this in a dark place).
1 pt standard soap solution. 1 cc—lather factor = 1 gpg soap hardness; lather factor marked on bottle, usually 0.3 cc.
1 qt neutral barium chloride 10%.
1 pt sodium hydroxide N/7.
1—8-oz bottle (with dropper) benzidine hydrochloride 2%.
1—8-oz bottle (with dropper) methyl orange indicator (keep in the dark).
1—8-oz bottle (with dropper) phenolphthalein indicator.
1—8-oz bottle (with dropper) potassium chromate (mark dropper to hold 1 cc).
1 gal distilled water.



Water Sampling

Be sure you get good water samples. Blow sampling points thoroughly before taking a sample. Take feedwater samples from the outlet of the filter on the water softener, boiler water samples from the continuous blowdown or blow the water column down for 1 minute and take a sample there. Cool samples to 80 F or room temperature. Before starting your tests, rinse the bottles, beakers or other vessels with a little of the sample water.

Keep Things Clean

Have a separate burette for each chemical you are to titrate and mark it clearly for that chemical. After each test, clean the sample containers, casserole, shaking bottle and other utensils by rinsing them in tap water, then in distilled water. Store the equipment in some kind of a closed cabinet.

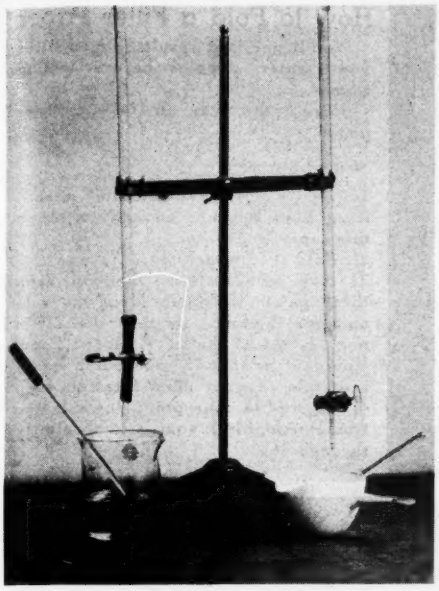
Stains that cannot be washed off with water may be removed with chromic acid solution.

Units

A great many chemists use units that give tests in parts per million. Many operators, however, use grains per gallon because you get direct test results without multiplying. In the following instructions, samples of 58.3 cc have been specified, which gives the results direct in grains per gallon from the burette readings. To change them to parts per million, multiply by 17.1.

If you want your tests in parts per million, (ppm) use a 50-cc water sample and multiply the burette readings by 20. In either case, you are reading cubic centimeters of reagent on the burette scale.

To convert water tests in parts per million to grains per gallon, multiply them by 0.06 or more accurately by 0.0583.



Plain Burettes

Titration—Don't Let the Word Scare You

All the tests described are based on one very simple idea. First, to a measured sample you add an "indicator," which colors the sample. Next you add a standard-strength chemical solution or "reagent," measuring this reagent as you add it, until a color change indicates that a "reaction" is completed. Finally, you record the measured amount of reagent added and from this, directly or by calculation, get the answer. The process of adding the reagent is called "titration," the verb being "to titrate."

Burettes—How to Use Them

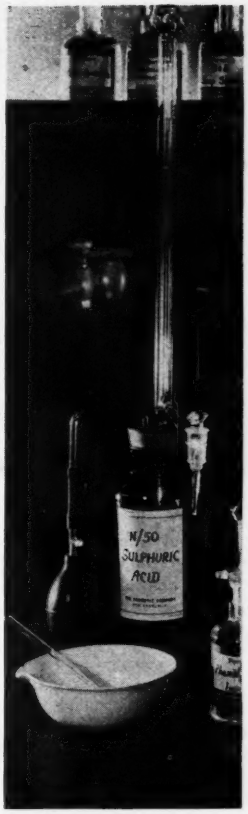
A burette is nothing but a long graduated tube, with the zero at the top and a glass stopcock at the bottom so arranged that you can let the contents of the tube run out into another vessel in measured amounts down to one drop at a time.

Reading Burettes and other graduated tubes—Any liquid in a small bore tube will have a concave surface called a "meniscus." Always read burettes, graduates and other vessels with the eye at the level of the low center of the concave liquid surface; i.e., the bottom of the meniscus. Never read the edges of the meniscus.

The plain burettes — left — should have funnel tops for ease of filling. At the bottom of the plain burette, you will find a ground-glass stopcock. Or, if the burette has a plain spout, fit a short piece of laboratory rubber tubing on it, with a pinch cock and a 3-in. length of glass tube. Burette stands may be purchased or may be fabricated from a laboratory ring-stand support. The one shown has a clamped bracket, on each end of which is welded an ordinary storage battery clamp to hold the burettes.

When using the plain burettes fill those you intend to use above the zero mark. Next open and close the pinch or stop-cock quickly to fill the lower tip and expel air bubbles. Then open slowly until the reagent comes to the zero mark. When tests are finished, rinse burettes with distilled water.

The automatic burette is as shown above. To prepare it for use you first fill the bottle half full or more with the solution to be used. Then you fill the burette by closing the vent with your thumb and pumping air into bottle with the rubber bulb until the solution runs well up into the glass bulb at the burette's top. Then release both vent and tube and the solution will automatically drain down to zero level. Now drain a little of it through the stop-cock to remove any air bubbles entrained in the cock. Finally, recharge the burette.



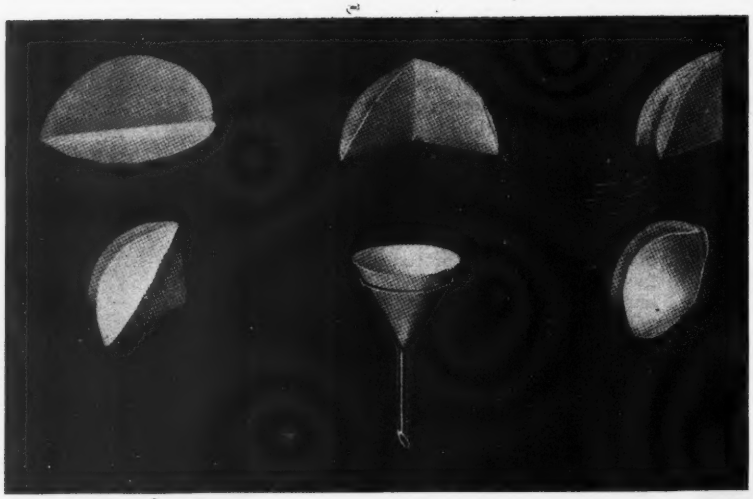
Automatic Burette

Soap Test for Hardness—Denoted by H

Measure 58.3 cc of water sample into an 8-oz. oil bottle. Add standard soap solution from the 10 cc glass stop-cock burette, a few drops at a time. Put the glass stopper into the bottle and shake the bottle vigorously after each addition of soap, until a lather forms that is fine grain and hangs to the side of the bottle. Then lay the bottle on its side. If lather lasts 5 minutes—OK. Read the burette. Number of cc of soap solution less lather factor marked on bottle = grains per gallon direct as calcium carbonate ($CaCO_3$). Record as (H). The lather factor is usually given as 0.3 cc since that represents zero hardness. For example: burette reading 5.8 cc — 0.3 cc = 5.5 cc = 5.5 gpg H or 5.5 × 17.1 = 94 ppm. If you started with a 50 cc sample, burette reading 5.0 cc, then 5.0 — 0.3 = 4.7 cc and 4.7 × 20 = 94 ppm H.

With raw water or undertreated filter or boiler water, you can get a false lather known as the "ghost" point, marked GP, which will appear before the permanent lather. This false lather will usually disappear if 0.5 cc of soap solution is added. After a few tests, you will know just about how much soap solution you will use so that you will only add one drop at the end to get a permanent lather.

If water takes more than 8 cc of soap solution use ½ or ¼ sample, add distilled water to 58.3 mark and multiply the cc of soap solution used by 2 or 4. Your boiler water should be between 0.1 and 0.5 hardness, without excess soda ash or phosphates and you can have it that way by testing daily. If it shows less than 0.1 cc you may be overtreating. At least you won't know unless your (P) and (MO) is high.



How to Fold a Filter Paper

You'll get best results if you filter your water samples before testing them.

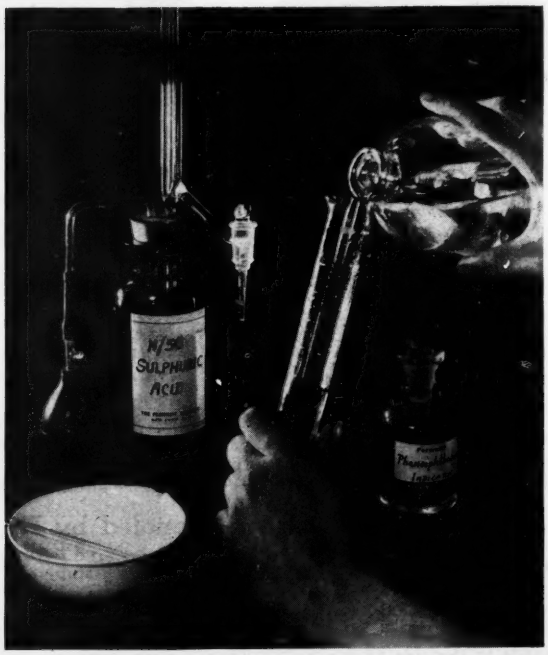
Here's the way to fold a filter paper.

1. Fold a single paper in half, crease it to hold but not enough to break the paper.
2. Fold it in quarters.
3. Now separate it so that you have three paper thicknesses on one side and one thickness on the other. It is now in the shape of a closed cone. You can see that if you pour a liquid into this cone, it must filter through
4. Insert the cone point down in the funnel and filter your sample slowly through it.

How to Test for P and MO Alkalinity

Collect a cooled sample of 200 or 300 cc, allow the sludge, if any, to settle. If not clear filter the top liquid into a beaker. From this, measure accurately into the graduated cylinder 58.3 cc of sample.

1



Then pour it into the 150-cc casserole. Add to it 3 or 4 drops of phenolphthalein indicator. If the water is neutral, it will stay colorless. If alkaline, it will turn red.

2

Next fill the 25-cc burette with N/50 sulphuric acid. Now titrate: that is, add the acid drop by drop to the sample in the casserole. Stir the solution well with the glass rod. Add acid from the burette drop by drop until *one final drop* causes the color to disappear. Record the cc of acid used as P.

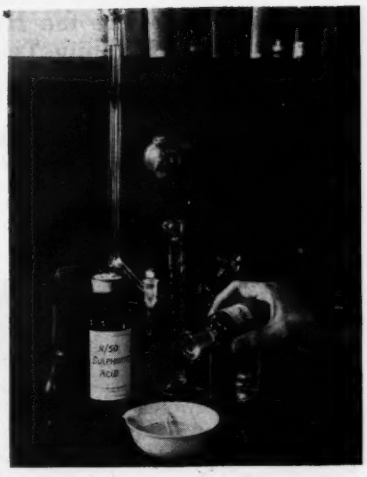
3

If for any reason you want only the methyl orange (MO) or total alkalinity, you can start with a 58.3-cc sample and proceed as below. However, if you have made the P test given on the preceding page, go right ahead, using the same sample, which you already have in the casserole.

Next, to the sample in the casserole add 2 drops of methyl orange. This will color the sample yellow.

4

Add more N/50 sulphuric acid from the burette, drop by drop, until the color changes from yellow to a light pink or orange. Don't add so much acid that the solution turns red, just enough to turn it pinkish or orange.



5

Calculations

Record the total acid used for P and MO. This is the methyl orange alkalinity, MO. The MO alkalinity is the total alkalinity. It always includes the P alkalinity. Example: P = 4.5; second burette reading MO = 6.8. P alkalinity = 4.5 gpg = 4.5 × 17.1 = 77 ppm. MO alkalinity = 6.8 gpg = 6.8 × 17.1 = 116.3 ppm.

If you cannot get a clear water sample use the barium chloride test ($BaCl_2$). This is often called the hydroxide alkalinity test and is preferred by many chemists. It is described on the next page.

How to Test for Solids

Place 100 cc of a sample in a weighed evaporating dish of 125 to 150 cc. Evaporate slowly over the steam or on a hot plate until all the water has disappeared. Put the dish and its dried material in a desiccator if you have one for 1 hr, then weigh. The increase in weight expressed in milligrams and multiplied by 10 equals total solids in parts per million. The difference between total solids in a filtered sample and an unfiltered sample of the same water equals the suspended solids.

A much more convenient method is to use a special type of hydrometer, like that shown, if this test is important enough to you to justify the cost of the device.

How to Make the Chloride Test (Cl)—It's Important—Make It Daily

For a sample, you can use the same one tested for P and MO or take a new sample. Place 58.3 cc of a filtered sample in the 150 cc casserole. Add 3 or 4 drops of phenolphthalein indicator. If the sample turns pink, run in N/50 sulphuric acid until the sample is colorless. Add 1 cc potassium chromate indicator to the sample. This will turn it bright yellow.

Now fill the 10 cc pinch-cock burette with silver nitrate solution and titrate. Add the silver nitrate drop by drop to the sample, stirring with the glass rod. The end point occurs when you get the first appearance of a permanent red tinge. Record the cc of silver nitrate used as gpg sodium chloride (NaCl). Yellow glasses will help to detect the end point.

If chlorides are high, use ½ or ¼ sample and add distilled water to make up to 58.3 cc. To get the results, multiply ½ sample by 2, ¼ sample by 4 = total chlorides as gpg sodium chloride. If soluble sulfite is being used in the boiler, a special test, not described here, but preferably made in the laboratory, must be used.

How to Make the Hydroxide Alkalinity Test

First filter a sample, take 58.3 cc of it, and make the P alkalinity test as described on page 74, recording the result as P.

Next filter another sample, pour 58.3 cc of this sample into the 150 cc casserole or in the 25 cc beaker. Add to the sample 10 cc of neutral barium chloride 10 per cent ($BaCl_2$), stirring the mixture vigorously.

1 →

Now, as in the other tests, titrate with N/50 sulphuric acid from the burette, stirring the sample well, until the red or pink color disappears on adding a final one or two drops of the acid. Disregard a re-appearance of the pink color. Record the acid used in cc as $P(BaCl_2)$.

3 →

The various forms of alkalinities are as follows:

$P(BaCl_2)$ = Hydrates as gpg calcium carbonate.

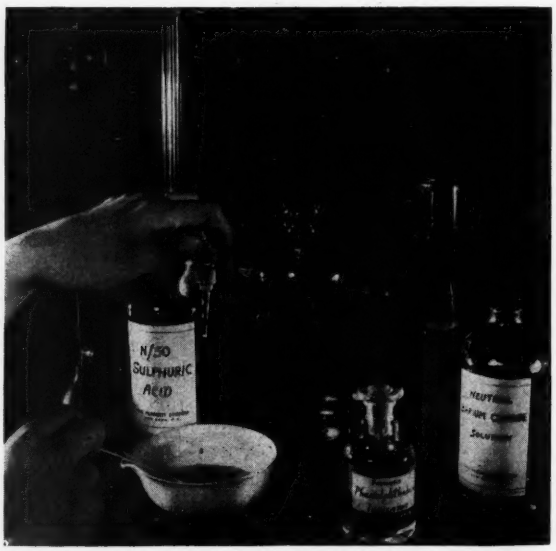
$[P - P(BaCl_2)] \times 2$ = Total carbonates as gpg calcium carbonates.

Total carbonates — (H) = Soda Ash as gpg calcium carbonates.

Hydrates + carbonates = True Alkalinity or (M) as gpg calcium carbonates.

Next add 5 drops phenolphthalein indicator, which will turn the solution red.

← 2



pH Test

A determination of pH or hydrogen ion concentration of water is often used nowadays in water treatment. The pH value of water measures its acidity or alkalinity. The modern and approved method of making a test for pH is by the use of an electrical measuring instrument, one type of which is shown, reading directly in pH. This test is much more sensitive than many of the chemical tests described here. All you have to do is place the electrodes of the meter in the water sample according to directions accompanying the meter, press a button on the instrument to turn on the electricity and the pointer indicates the pH on a scale.

How to Test for Dissolved Oxygen

This test can be made by a boiler room operator if care is taken in sampling and the instructions are followed accurately. When using an open feedwater heater, this is not a routine test. However, it is given because you may need to know it sometime. You will need solutions of manganous sulphate, alkaline potassium iodide, concentrated sulphuric acid, N/40 sodium thiosulphate and starch solution. Buy these all prepared unless you are a chemist.

You will need an 8-oz or 9-oz (250 to 270 cc) glass-stoppered sampling or tincture bottle or a special sampling bottle not shown. If using a standard bottle, pass the sample into it, after cooling to about 70 F, by using a glass or rubber tube extending to the bottom of the bottle. Let the water flow through the bottle slowly, spilling out the top, for 5 min wasting not less than 5 times the capacity of the bottle. Withdraw the sampling tube from the bottle before shutting off the water and put in the glass stopper.

Next remove the glass stopper from the sample bottle and add 1 cc of manganous sulphate solution and 3 cc of alkaline potassium iodide, using separate pipettes for each solution. Run the ends of the pipettes to the bottom of the sample bottle and discharge the chemicals at the bottom. Replace the stopper, shake the bottle and let it stand 5 min. A brown precipitate will settle.

Next remove the stopper again, add 2 cc of sulphuric acid, replace the stopper and shake the bottle. The acid will dissolve the precipitate. It must all be dissolved. Up to this point work as quickly as possible, but the remainder of the test may be delayed several hours without introducing errors.

Next pour 200 cc of the treated sample into a 500-cc flask and titrate it with the N/40 sodium thiosulphate solution until the yellow color *nearly* disappears. Sodium thiosulphate solution is not permanent and should be standardized against 0.025/N solution of potassium dichromate.

At this point, put ½ cc of the starch solution into the flask. This will turn the sample from yellow to blue. Now titrate again with sodium thiosulphate from the burette until the blue color just disappears.

Read the sodium thiosulphate burette. The amount used in cc will be the dissolved oxygen expressed in parts per million by weight.

How to Test for Sulphate by the Benzidine Method

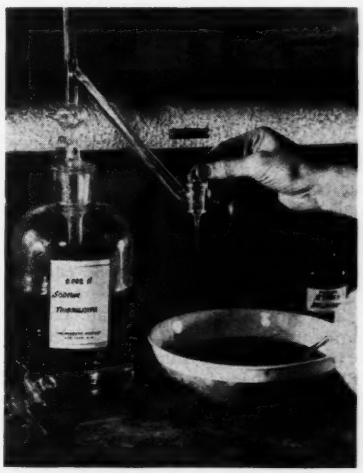
Place 58.3 cc of filtered sample water in the 250 cc Erlenmeyer flask with 10 cc of benzidine hydrochloride solution and mix them by whirling the flask. Let the mixture stand 10 or 15 min for a precipitate of sulphate to form. Now pour the solution through a small filter paper. If it comes out cloudy, pour it through the same filter paper a second time. The sulphate precipitate, of course, remains on the paper.

To tell if all the sulphates have been precipitated, add (1) one drop of benzidine to the clear filtrate, that is, the liquid that has passed through the filter paper. If the liquid turns cloudy, start the procedure all over using ½ or ¼ sample of water. Continue until all the precipitate is on the filter paper and a drop of benzidine does not turn the filtrate cloudy.

Rinse the emptied flask with 25 cc of distilled water. Pour the rinse water through the same filter paper which is still in the funnel, to wash the sulphate precipitate. Allow the rinse water to drain through the filter paper completely before adding more rinse water. You let the rinse water run to waste, also the clear filtrate.

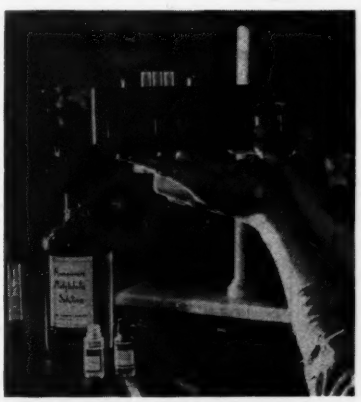
Now remove the filter paper carefully from the funnel and place it in the original Erlenmeyer flask that you first put the sample into. Then put in the flask 25 cc of distilled water, putting it in with the 25-cc pipette. Add 2 drops of phenolphthalein indicator and titrate with N/7 sodium hydroxide (using the 10 cc pinch-cock burette) until a pink color shows. That will last for at least ½ minute. A swirling motion to the flask at first will break up the filter paper near the end.

Place the rubber stopper in the flask and shake the flask after each addition of N/7 sodium hydroxide. Record the burette reading of N/7 sodium hydroxide and multiply reading by 10 for the 58.3 cc sample, or by 20 for a ½ sample or 40 for a ¼ sample. Then record as gpg sodium sulphate. There are, of course, other ways to test for sulphates.



The Phosphate Comparator

Comparators of various manufacturers differ slightly in arrangement and details, and each is supplied complete with necessary chemicals and full instructions for use; you have only to consult the instructions. Most of them are based on the principle of treating a sample of water with chemicals that color it in proportion to its phosphate content and then comparing that color with standard colors representing known concentrations of phosphate. The illustration below shows one of the well-known makes of phosphate comparator.



How to Interpret Your Tests

Now you have your test readings. If you are using prepared compounds you can check them daily. If you use soda ash with sodium aluminate or phosphate, you can tell the amount of each to use. When using free phosphate in the boiler, you will require a phosphate comparator.

You will use the tests with both hot and cold lime soda softening. The October and December, 1944, issues cover hot process. For cold process, your H reading from softener will be from 1 to 2 gpg. Excess soda ash, 3 to 5 gpg. Lime or caustic soda excess, 1 to 4 gpg. The final test of the boiler water is what you will adjust your softeners by. Never use lime in the boiler. For internal treatment you should keep the H reading between 0.1 and 0.5 gpg and the MO between 10 and 23 cc alkalinity.

Use the chloride test to check the amount of condensate return, concentration in the boiler, and amount of blowdown. For example, raw make-up water has 0.5 gpg chlorides. Water from heater shows 0.3 gpg chlorides. Boiler water shows 7 gpg chlorides. Ratio of dilution: $(0.3 \times 100) \div 0.5 = 60\%$. Then $100\% - 60\% = 40\%$ condensate. Percentage blowdown: 7 divided by $0.5 = 14$ times water has concentrated in boiler. Per cent water lost is the reciprocal of 14 or $1 \div 14 = 0.0769 = 7.69\%$. Calorimeter shows 2% moisture in steam; then the blowdown $= 7.69\% - 2\% = 5.69\%$ blowdown. The ratio of total chlorides to dissolved solids in a completely treated boiler water remains constant.

Sulphates (SO_4) are explained in October and December, 1944, issues.

Methods of Condensing Refrigerants*

Advantages and disadvantages of the three commonly used types of refrigerant condensers, i.e., air cooled, shell and tube, and evaporative . . . Working principles of each type are outlined . . . Applications are suggested . . . Construction of evaporative condenser described in detail

By H. J. KINKADE Engineer, Young Radiator Co.

MEANS most commonly used for condensing refrigerant vapors are of three types: (1) air cooled condensers; (2) shell and tube condensers, and (3) evaporative condensers. Properly applied, each of these offers a good and practical method and each has its own field of application where it is predominantly used.

The air cooled condenser is used mostly for small refrigeration units of 3 hp or less. Such applications cover practically all household refrigerators and small commercial refrigerators; also a great many small air conditioning jobs such as individual room coolers. Air cooled condensers are also used on larger installations where water is not available, such as bus and railroad car air conditioning.

The advantages of the air cooled condenser may be listed as follows:

1. Low cost in small sizes.
2. Simplicity.
3. No water required.

Its disadvantages may be listed as follows:

1. High cost in large sizes.
2. Comparatively large amount of air needed.
3. Cost of power to move large amount of air.
4. More horsepower needed to drive the compressor due to the high head pressures with air cooled condensers.
5. Lowest capacity in hot weather when the highest capacity is needed.

*Revision of an address delivered before the Richmond section of ASRE, May 7, 1945.

Shell and Tube Condensers

The shell and tube condenser may be used for any size refrigeration job. It is low in cost and efficient in operation. The application of shell and tube condensers is usually divided into two parts: (1) when used with well water or city water run to waste, (2) when used with a cooling tower.

Where a shell and tube condenser uses well water or city water which is allowed to run to waste, its advantages are as follows:

1. Low first cost.
2. Low compressor operating cost.
3. Low maintenance cost.

Its chief disadvantage is the high cost of the city water used; or in case of well water, the high cost of pumping a large quantity of water. Some cities will not allow this method of condensing at all, due to a shortage of water or to overloading of sewers with the used water.

A great many such systems are in operation since it is almost universally used on all refrigeration jobs of less than 7½ compressor horsepower where water and sewer connections are readily available. This system is also used on many large jobs when a plentiful supply of cool water is available at low cost.

When a shell and tube condenser is used in conjunction with a cooling tower, the objection of water cost disappears. The water is continually re-cooled and re-circulated, and the only loss is from evaporation and windage. Such a system has many advantages where water is scarce, or costly, or warm. It is used on the largest sizes of refrigeration compressors as well as many smaller sizes. When the water used for condensing the refrigerant vapors is cooled in such an evaporating system, the head pressure against which the compressor must operate may be kept low most of the operating time. This results in low operating cost for the compressors.

The disadvantages of such a system are as follows:

1. High first cost of the cooling tower, cooling tower basin, pumps, piping, and erection.
2. High cost of pumping a large volume of water through the condenser and through long pipe lines to and from the cooling tower.
3. Cooling tower is outdoors and subject to freezing in winter.
4. Maintenance cost is comparatively high.
5. The nuisance of water drifting from the tower.

Evaporative Condensers

The evaporative condenser was designed to utilize the advantages of the condensing system using a shell and tube condenser with a cooling tower, without its disadvantages. The chief disadvantages of the evaporative condenser is high first cost and high maintenance cost. The initial cost of evaporative condenser is usually less than that of a comparative cooling tower with shell and tube condenser when the cost of pumps, piping and erection are all figured; but it is still rather high. The evaporative condenser requires cleaning scale from the coils, cleaning of the sump pan and nozzles, and oiling of

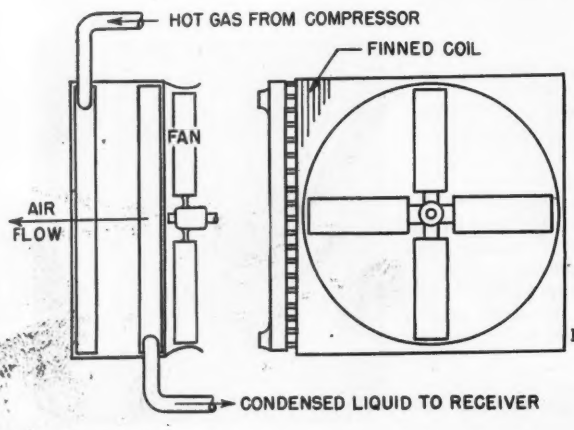


Fig. 1. (Left) Principal elements of an air cooled condenser

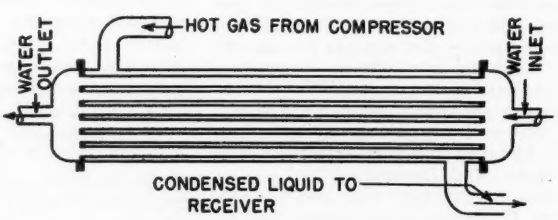


Fig. 2. (Above) Cross section of horizontal type shell and tube condenser

the pump, motor and fan shaft bearings at reasonably frequent intervals.

It has, however, certain inherent advantages which very well offset the disadvantages. It is usually placed inside the machine room where it is constantly under the eye of the operator. It is close to the compressor for ease of service and operation. It is indoors where it is not so subject to freezing as the cooling tower. It has only a small pump for the spray water. Any scale formation on the tubes is external where it can be observed, not hidden inside as is the case with a shell and tube condenser. The horsepower required to drive both the fans and spray pump is usually less than that required for the pump on a cooling tower.

In operation, the evaporative condenser is essentially an indoor, induced draft cooling tower with the refrigerant coils suspended in the high velocity air and water streams so that the efficiency is high and a large amount of cooling can be done with a small compact unit.

Small sizes of evaporative condensers are usually constructed in only one section. Larger sizes may be made in two separable sections with the fans in one section and the coils and sump in another. The largest sizes are usually made in three separable sections.

1. Fan section.
2. Coil section.
3. Sump section.

Construction Details

The fans and fan housings of an evaporative cooler require careful protection against the effects of the hot moist air in which they operate. They should be hot dip galvanized after fabrication, after which the fan wheels must be balanced. The fan housings are sometimes additionally protected by a coat of asphalt mastic.

The fan shaft is usually of cold rolled and ground shafting. The eliminator plates are usually hot dip galvanized after fabrication. Fans, fan housings and fan shaft are sometimes made of stainless steel, but this is very expensive material, and its use is justified only in especially corrosive conditions.

Refrigerant coils are made with steel tubes for ammonia or with copper tubes for Freon or Methyl Chloride. Coils may be of bare tubing or of finned construction. If steel coils are used they must be hot dip galvanized or otherwise suitably protected against rust and corrosion.

The water for evaporation on the coils may be sprayed on, dripped on, or splashed up onto the coils. Spraying through large orifice nozzles is the most usual method of water distribution. Only a very small amount of water is needed for evaporation, but a large excess of water is usually sprayed over the coil to assist in washing down the coil and to be sure that all coil surfaces are continuously wetted. A large excess of water requires more power on the spray water pump, but this is such a small item of cost that it is usually discounted.

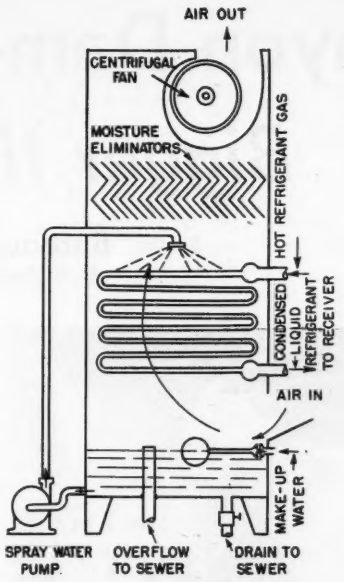


Fig. 3. Elemental features of the evaporative type condenser

All the interior metal surfaces of the evaporative condenser must be well protected against rust and corrosion. This is especially true of the sump pan.

The evaporative condenser should be installed as near the compressor as is practical in order to avoid long refrigeration piping. It should also be near a wall or otherwise located so that the discharged air may be readily conducted outdoors. Air ducts should be as short and straight as possible. The air from the evaporative condenser should not be discharged near the intake of the unit. It should not be discharged anywhere that the hot moist air would be objectionable. Evaporative coolers are sometimes placed outdoors or on a roof to eliminate air ducts. This is often done in the south where little danger of freezing is encountered.

Evaporative coolers do not cause much vibration. Any concrete floor 4 in. thick or thicker should be suitable for their installation.

Heavy piping should not be hung on the cooler, but should be supported externally.

Care in Operation

After installation, the voltage and amperage of the fan motor should be checked for possible overload. The quantity of air should be checked against the manufacturer's recommendations. The water pressure at the spray pump discharge should be checked. If any of these are not what they should be, steps should be taken to correct them before placing in operation.

Almost all water has scale forming properties, so it is usually advisable to treat the make-up water continuously to minimize scaling as much as possible.

Like any other piece of machinery, an evaporative cooler requires some service. It is advisable on monthly inspection to check the coil and spray nozzles for scale and obstruction; to oil the fan bearings; and to clean the strainer at the spray pump suction in the sump.

Once every year the cooler should be thoroughly inspected for rust and corrosion. This inspection should include the fan wheels and housings as well as all parts of the frame and enclosure. Rust should be cleaned off and paint applied where needed. Any parts rusted or worn beyond use should be replaced. At this yearly inspection the spray pump should be taken apart and cleaned. The sump pan should be cleaned out and repainted if necessary. Ball bearings on the motors or other places should be greased.

The evaporative condenser is a simple piece of machinery, but it does require some attention. If properly installed and serviced, it should give satisfactory use for many years.

Nation's Coal Needs

SOLID FUELS ADMINISTRATOR Harold L. Ickes recently made the following statement:

"Estimates submitted on August 22 by the Solid Fuels Requirements Committee show that during the fuel year ending next March 31, the Nation will need from 570,000,000 to 585,000,000 tons of bituminous coals, depending upon how much we can make available for export to Europe. We do not intend to send Europe any of the coals normally used here for home heating.

"It is hoped that our original production estimate of 575,000,000 tons for this period can be reached, although we must have continuous peak operations on a most favorable basis to attain it.

"There will be little change in anthracite requirements or production over estimates made prior to Japan's defeat.

"The Army, Navy, and Marine Corps reported that their requirements for the coal year are unchanged by the defeat of Japan. The War Production Board and SFAW estimate that requirements for home heating and other non-industrial consumption will be unchanged and in fact would be larger if we had the coal. The Foreign Economic Administration's requirements for export coal showed an increase, and the War Production Board believes that the cement mills will need more coal than before Japan fell. Relatively small decreases were reported for all other categories of industrial consumers, the largest of which was in general manufacturing which represents about 15 per cent of our total consumption."

Bridge Canyon Dam—
Bigger than Boulder

By the **Bureau of Reclamation**
U. S. Department of the Interior

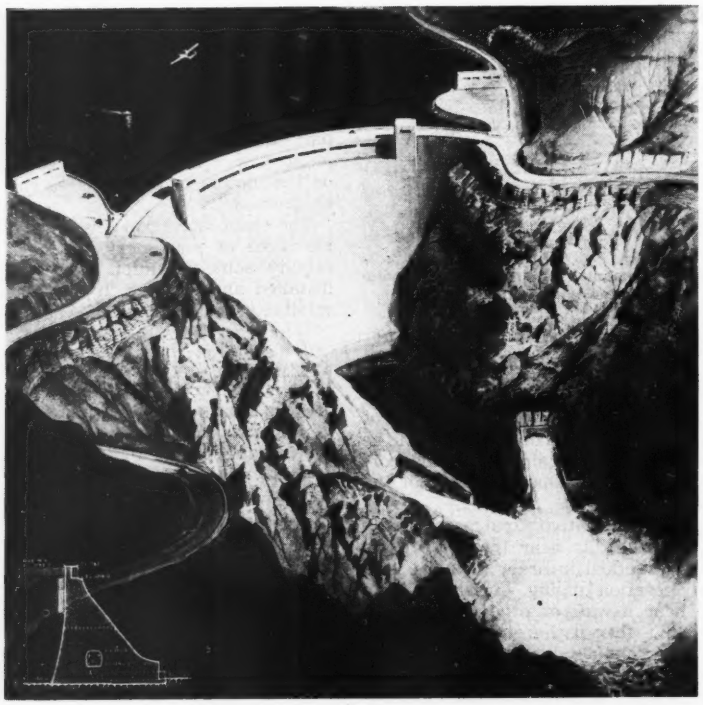


Fig. 1. Artist's conception of proposed Bridge Canyon Dam

A POWER PLANT to be enclosed in the body of a concrete dam higher and larger than Boulder Dam, the highest capacity hydroelectric power generating units ever installed, and provisions for silt control—these are some of the innovations featuring the Bureau of Reclamation's preliminary designs for the proposed Bridge Canyon Dam to be located on the Colorado River 118 miles upstream from Boulder Dam at the upper end of Lake Mead. Bridge Canyon Dam will create a reservoir extending 80 miles upstream to Grand Canyon National Park, and will store 3,700,000 acre-feet of water and provide head for a generation capacity of 750,000 kw.

Already constructed on the Colorado River by the Bureau of Reclamation are Boulder and Parker Dams with ultimate generating capacities of 1,322,300 and 120,000 kw, respectively. Construction of Davis Dam, located about midway between Boulder and Parker; Fig. 3, was stopped during the war but is expected to be resumed when the project is cleared by the War Production Board. The Davis Dam Power Plant will have 225,000 kw of capacity.

With the construction of Bridge Canyon and Davis Dams, more than 300 miles of the once turbulent and unharnessed Colorado will be an almost continuous chain of lakes storing water for irrigation, flood control, and power generation. Utilization of the drop of nearly 1,500 feet from the normal water surface of the Bridge Canyon Reservoir to the tail water at Parker Dam will make possible a generation capacity of 2,417,300 kw by the four major dams.

The extremely rugged canyon topography of Bridge Canyon Dam site, which is located in Granite Gorge, is similar to that of the Grand Canyon of the Colorado, and heavy construction will be necessary to provide access facilities to the site before work can begun on the dam. Reclamation engineers estimate that preliminary construction including access and housing facilities will involve the expenditure of 12 per cent of the total cost of the project.

Extensive geologic investigations have established the competency of the granite gneiss rock foundation, and have disclosed no structural defects of importance.

General Features

Bridge Canyon Dam, as now planned, with a maximum height of 736 ft, will be 10 ft higher than Boulder Dam. It is designed as an arch-gravity structure with a crest length of 1,950 ft and will contain 5,650,000 cu yd of concrete. These dimensions and quantities will make Bridge Canyon the world's highest dam and the third with respect to mass.

Design problems were similar to those encountered in the design of Boulder Dam with respect to consideration of the stresses and foundation pressures of a very high dam, diversion of the river flow during construction, spillway provisions for discharging flood waters over long vertical distances, and the placing and cooling of a large concrete mass. However, the locating of the power plant within the dam and the inherent problem of Colorado River silt required special consideration in design investigations and provisions peculiar to this one structure.

Flow of the river during construction in the bottom of the gorge will be diverted by cofferdams through 50-ft diameter tunnels, one in each canyon wall. The upstream portions of these tunnels will be plugged when they are no longer needed for diversion, and the downstream sections will be lined with concrete and connected to the spillways by inclined shafts, which will also be concrete-lined.

The spillway intakes will be located just upstream from the dam on each abutment, and the discharge of flood waters through each spillway will be controlled by two 50- by 60-ft Stoney gates. Combined capacity of the two spillways is 400,000 cfps, and the velocity of the flood waters will approach 175 ft per sec in their descent from the reservoir surface to the river channel below the dam. Model studies are now in progress in the Reclamation hydraulic laboratory in Denver to investigate the efficiency of the system as now designed and

Power plant to be enclosed in concrete dam . . . Highest capacity hydroelectric generating units yet installed; 170,000 hp each (125,000 kva), 560 ft head, 180 rpm . . . Silt control . . . Bridge Canyon Dam, 118 miles up Colorado River from Boulder Dam, will increase utilization of river drop to 1500 ft, making 2,417,300 kw of capacity available from four major dams of system

to determine whether modification will be required to provide the proper hydraulic properties.

Steel-lined, 102-in. diameter outlet conduits through the dam will provide facilities for sluicing the silt from the reservoir and for regulation of the reservoir. A cross section of the dam shows these conduits located some 240 ft below the lower tier of intakes to the power penstocks. Each outlet conduit will be controlled by two ring follower gates located near the upstream face of the dam.

Power Plant Arrangement

The power plant and the transformer deck will be contained entirely within the dam. Economy and the avoidance of spray interference with the electrical mechanism were the major considerations responsible for this arrangement which also provides security from aerial warfare. Openings at two elevations in the upstream face will admit water to the vertical power penstocks leading to the six 125,000-kva generating units. Whenever possible the upper intakes will be utilized, to prevent entrance of silt into the penstocks.

The generating units will be located in the dam near the upstream face in a chamber 70 by 70 by 600 ft that provides as much room for equipment and facilities as is found in the conventional power houses appurtenant to dam structures. A 6- by 8-ft shaft will lead from each generator to the transformer deck and will contain an air ventilator and bus. The transformer deck is located just below the crest of the dam.

Entrance and exit of power plant equipment and machinery will be by railroad car or truck trailer via tunnels at the power plant level and at the top of the dam, connected by a 25- by 62-ft elevator shaft in the left abutment. A tunnel at the elevation of the transformer deck will also lead to the elevator shaft.

For the transportation of operating personnel and equipment, an elevator within the dam will connect with the inspection galleries, outlet gate chamber, and power plant.

Turbines and Generators

The turbines are designed for a rating of 170,000 hp at 560-ft head and will operate at 180 rpm to drive

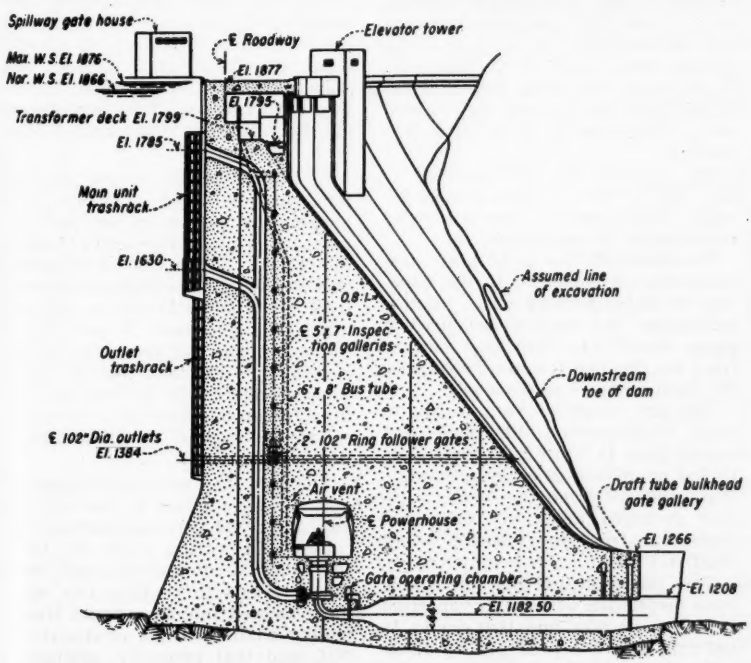


Fig. 2. Cross-section of Bridge Canyon Dam (preliminary design), showing power house enclosed in dam

Fig. 3. Map showing plans now being considered, involving full development of Colorado River and its relation to Central Arizona Project, for which it would supply water either (1) from Marble Gorge Plant through tunnel to Verde River, or (2) from Bridge Canyon Dam through tunnel and canal or (3) by pumping from Parker Dam via a canal

the 125,000-kva vertical-type generators. Maximum operating head will be 665 ft and the minimum head 430 ft. The turbines and generators will have higher rated output than any water wheel units in existence today and probably approach the limits of design. Streamline butterfly valves are placed just ahead of the turbines, in addition to the emergency shutoff gates at the penstock entrances.

The turbines will discharge through draft tubes into elliptical tunnels 44 ft high by 15 ft wide. To prevent the water column beneath the turbine runner from parting and then reclosing, causing destructive rises in water pressure within the conduit upon sudden loss of load on the unit, it will be necessary to provide air relief at the nominal end of the draft tubes by means of air inlet valves.

The discharge ends of these tunnels bear an upward tilt at the bottom to form a continuous weir to insure turbine seal at all times, regardless of tailwater elevation. The weir will also serve to prevent the washing of silt back into the tubes.

Due to the high head and close tolerances, the turbines will require more frequent maintenance than machines operating under low head. Provision is made in the design for service and maintenance of the turbines without dismantling the generators.

Activities of the Bureau of Reclamation are under the direction of Harry W. Bashore, Commissioner, and are under the jurisdiction of Harold L. Ickes, Secretary of the Interior. Design and construction are directed by Walker R. Young, Chief Engineer.

Tests to Determine Qualities of Amine

An investigation of the properties of cyclohexylamine[1] under conditions applicable for controlling CO_2 corrosion in condensate return lines — Amine found to be condensable in steam but will undergo decomposition — Amine in condensate lowers electrical resistance—Decomposition of amine to free ammonia may increase corrosion

By **MAX GELFAND** Chemist, Dallas Power & Light Co.

REPORTS[2, 3] have been made that cyclohexylamine when dissolved in water will, upon distillation, distill over and condense with the condensate, thus increasing the pH value of both the steam and the condensate, and combine with the CO_2 to remove the effect of this gas upon corrosion. For this phenomenon to be true the amine must be:

a. Water soluble.
b. Steam soluble.
c. Non-reactive with other water soluble constituents as usually found in boiler water.
d. Stable to heat as that produced in boiler water and steam.
e. Able to increase the pH value of the steam and condensate by the presence of small quantities.
f. Able to inhibit corrosion by its presence. (NH_3 will react with water to produce NH_4OH and raise the pH value. However, the presence of volatile ammonia in water increases the rate of oxidation of iron and increases the solubility of copper and its alloys.)

Laboratory tests have shown that the amine is soluble in water in all proportions. When vaporized with the steam, however, it separates in form of droplets and upon mixing with the condensate again goes back into solution. (This separation of the amine and the steam will probably not retard corrosion as the pH value of the steam and CO_2 present will be unaffected.)

The amine has a distinct alkaline reaction. When titrated with a standard acid solution, one part per million alkalinity at pH 8.2—in terms of $CaCO_3$—is equivalent to 3.25 ppm of the 60 per cent amine concentrate, having a specific gravity of 0.934 at 60 F.

Effect of Amine on pH of Water

Tests made to determine the effect of pH on the addition of the amine to distilled water showed that the presence of very small quantities greatly affected the pH value; 4.7 ppm amine concentrate raised the pH value from 6.8 to 9.6. Additional quantities, however, produced only a slight change in pH value; 450 ppm of the amine concentrate increased the pH value to 10.2.

The amine reacted as an electrolyte. A sharp decrease in resistance was produced by the presence of small quantities. It was found that 5 ppm of the concentrate reduced a water of 23,000 ohms to 10,000 ohms.

It is possible that the amine may be lost by volatilization. If the chemical were injected into the condensate return lines it would all eventually pass through the boiler and upon vaporization with the steam would pass through the condensers, which are kept under high vacuum and where the initial loss might occur. Thus to determine the reaction of the amine under comparable conditions, fractional distillation tests at atmospheric pressure were made. (Temperature of the condensate 90 F.)

These tests showed that the presence of NaOH increased the volatility and recovery of the amine. In comparison, the distillates recovered from solutions containing equal quantities of amine dissolved in distilled water and in water containing NaOH, 9 per cent more of the amine was recovered from the caustic solution and a total of 90 per cent recovery was obtained when 25 per cent of the solution was distilled. A maximum of the amine recovered from the distilled water solution was 81 per cent when 42 per cent of the solution was distilled.

An analysis of approximately 10 per cent of the solutions left as residual in the boiling vessels showed the absence of any amine.

The conductivities of both of these distillates corresponded to the quantity of amine present. The solution containing the caustic produced a purer distillate than that derived from the distilled water solution once the total amine was removed.

The pH values of both distillates were comparatively the same and varied from 11.5 to 8.1 corresponding to the quantities of amine present—that produced from the NaOH solution averaged about 0.3 pH lower than that from the distilled water solution.

This test indicated that the amine upon distillation with water vaporized before the water and that up to 19 per cent loss was produced by distillation at atmospheric pressure with the condensate at 90 F.

From the pH vs. concentration curves it was noted that 5 ppm of the amine concentrate would produce a pH value of 9.7 in the distillate.

Volatilization of Amine

Assuming that if all the amine would distill over with the water, a distillate would be produced containing the amine and the corresponding pH value. Tests made to determine such recovery of the amine in the distillate from a typical boiler water compared to the distillate produced from a sample of the same boiler water containing zero amine showed no definite change in pH value, although a slight change in the purity of the condensate was observed.

Analysis of the distillate resulting from the amine solution and the fraction of the residual solution left in the glass boiler showed the absence of any of the amine. The conclusion was that the amine was lost by volatilization as a non-condensable vapor.

To confirm these results samples of water—one containing 936 ppm of the amine concentrate + 600 ppm NaOH in distilled water and another containing 936 ppm amine, without addition of a caustic, in distilled water—were placed in glass boilers and allowed to boil for 24 hr under reflux condensation. The temperature of the refluxing condensate being 90 F.

At the end of this period the solutions were allowed to reach room temperature and tested for the quantities of amine present. Results showed that 55 per cent of the amine was lost as a non-condensable vapor from the water solution not containing NaOH and that 76 per cent of the amine was lost from the solution containing the caustic, that the amine was decomposed by boiling and that the addition of a caustic to the amine solution increased the decompensation of the amine.

The fact that ammonia compounds may be decomposed to liberate free ammonia (NH_3) by the addition of a caustic and heating, led to the belief that such decomposition had taken place. Tests to confirm this statement showed that the vapors from a boiling amine solution produced free NH_3 and that upon the addition of

(Text continued on page 86)

[1]Western Chemical Co.—"Varvol."
[2]Bureau of Mines, Bul. RE. 3754, June, 1944, A. A. Berk.
[3]Power Plant Eng., May, 1945, A. A. Berk.

AMINE TESTS

(60 per cent Solution of Cyclohexylamine) Specific Gravity at 60 F 0.9340

Standard solution prepared by diluting 1cc to 2000 cc or 1 cc = 0.000467 gm amine . 1 mgm = 6 ppm P alk as $CaCO_3$.

TEST NO. 1—Alkalinity Tests **TEST NO. 2—pH Tests**

cc Standard Solution	Dil to 50 cc with H_2O	Gm Amine	P alk as $CaCO_3$ ppm	ppm Amine	pH Value
50	"	0.0235	141	467	10.2
25	"	0.0117	70.5	234	10.0
10	"	.00467	28.0	93.4	—
5	"	0.00235	14.1	46.7	—
1	"	.000467	2.8	9.3	—
.5	"	0.000235	1.4	4.7	9.6
.1	"	.0000467	0.3	0.9	8.2
0	"	Zero	Zero	Zero	6.8

TEST NO. 3—Conductivity Tests

To 250cc H_2O (distilled) add standard solution.

Add cc	Total Vol. cc	ppm Amine Compound	Meter Rd. × 5000	°F	Resist at 77°F Ohms
0.0	250	0	808	77	21 450
0.1	250.1	0.186	793	77	19 155
0.5	250.6	1.118	789	77	18 700
1.0	251.6	2.969	735.5	77	13 900
2.0	253.6	6.62	661	77	9 750
5.0	258.6	15.53	505	77	5 100
10.0	268.6	32.33	355	77	2 752
15.0	283.6	55.32	261	77	1 766
20.0	303.6	82.44	205	77	1 290
25.0	328.6	111.70	169	77	1 017
35.0	363.6	145.9	143	77	835
50.0	413.6	184.7	126	77	721

TEST NO. 4—10cc standard solution—pH value 9.6 in condensate diluted to 1000cc with boiler water (No. 5 boiler—May 22, 1945). Water distilled at atmospheric pressure and distillate tested.

Sample No.	cc Distilled	Total Distilled	P Alk	ppm as $CaCO_3$	pH	Meter Rd. × 5000	F	Correct Resist. 77 F
1	100	100cc	0.0	0.0	8.1	639	86	9 735
2	110	210	0.0	0.0	8.1	847	86	30 448
3	105	315	0.0	0.0	8.1	889	86	44 050
4	120	435	0.0	0.0	8.1	919	86	62 370
5	110	545	0.0	0.0	8.1	222	86	64 130
6	120	665	0.0	0.0	8.1	895	86	48 882
7	115	780	0.0	0.0	8.1	919	86	62 370
8	95	875	0.0	0.0	8.1	914	86	58 465
		Distillate from Boiler Water (1000cc)						
1	120	120	0.0	0.0	8.1	813	86	23 914
2	120	240	0.0	0.0	8.1	917	86	60 775
3	110	350	0.0	0.0	8.1	926	86	68 805
4	125	475	0.0	0.0	8.1	928	86	70 895
5	135	610	0.0	0.0	8.1	932	86	75 405
6	110	720	0.0	0.0	8.1	922	86	64 130
7	140	860	0.0	0.0	8.1	907	86	53 642

Intense priming and carry over is produced by the amine in the presence of NaOH in concentrations above 1000 ppm amine plus 1000 ppm NaOH. High concentrations of NaOH precipitate the amine from solution. Any additional amine will separate from the NaOH solution. During distillation of the amine solution the amine separates from the steam. Upon condensation, droplets of the amine will collect, fall into the condensed water, where solution again re-occurs.

1 ml amine (0.936 Gm) dil to 1000 ml with H_2O-fractional distillation.

Sample No.	ml Collect	ml Total	P alk as $CaCO_3$ ppm	pH	Meter R. × 5000	F	Resist. Ohm 77F	% Amine Recovered
1	150	150	1388	11.0	16	83	89	72.44
2	155	305	140	10.1	75	83	446	80.00
3	115	420	20	9.8	237	83	1708	80.79
4	130	550	12	8.3	476	83	4996	81.34
5	115	665	0	8.1	698	83	12711	81.34
6	120	785	0	8.1	810	83	23447	81.34
7	115	900	0	8.1	767	83	18100	81.34

1 ml Amine (0.936 Gm) + (0.6 Gm NaOH) dil to 1000 ml

Sample No.	ml Collect	ml Total	P alk as $CaCO_3$ ppm	pH	Meter R. × 5000	F	Resist. Ohm 77F	% Amine Recovered
1	120	120	1968	11.0	13	83	72	82.18
2	120	240	188	10.2	69	83	408	90.05
3	115	355	12	9.7	269	83	2025	90.53
4	115	470	0	8.2	708	83	13338	90.53
5	135	605	0	8.1	922	83	65010	90.53
6	130	735	0	8.1	913	83	57695	90.53
7	110	845	0	8.1	922	83	65010	90.53

TEST NO. 5—Loss on volatilization—reflux for 24 hours at atmospheric pressure. Temperature of returning condensate 90 F.

Sample No.		600 ppm NaOH Finish	% Amine Lost
	Start	416 ppm amine	55.55
1	936 ppm amine	221 ppm amine +	76.39
2	936 ppm amine plus 600 ppm NaOH		

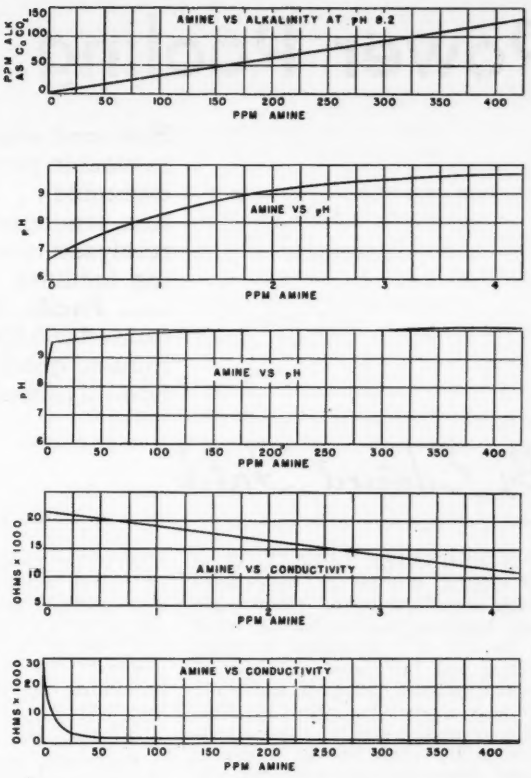
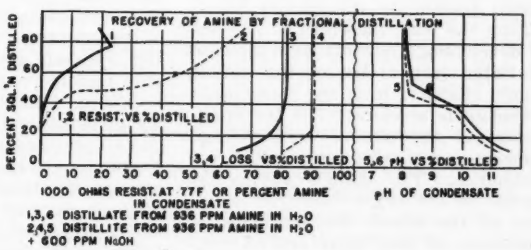
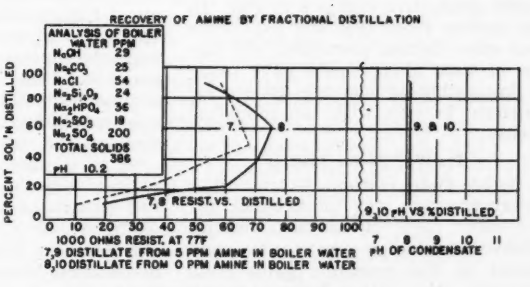


Fig. 1. Variation of amine content with alkalinity, pH value and conductivity


RECOVERY OF AMINE BY FRACTIONAL DISTILLATION
PERCENT SOL'N DISTILLED
1,2 RESIST. VS % DISTILLED
3,4 LOSS VS % DISTILLED
5,6 pH VS % DISTILLED
1000 OHMS RESIST. AT 77F OR PERCENT AMINE IN CONDENSATE
pH OF CONDENSATE
1,3,6 DISTILLATE FROM 936 PPM AMINE IN H_2O
2,4,5 DISTILLITE FROM 936 PPM AMINE IN H_2O + 600 PPM NaOH



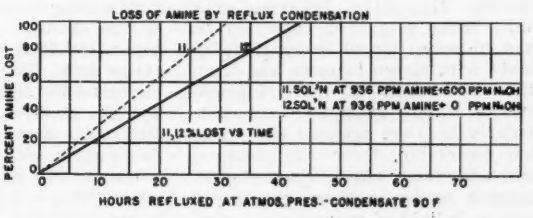

LOSS OF AMINE BY REFLUX CONDENSATION
PERCENT AMINE LOST
11 SOL'N AT 936 PPM AMINE + 600 PPM NaOH
12 SOL'N AT 936 PPM AMINE + 0 PPM NaOH
11,12 % LOST VS TIME
HOURS REFLUXED AT ATMOS. PRES. - CONDENSATE 90 F

Fig. 2. Amine recovery and loss curves

Power Pooling During the War

How and why regional power pooling was a vital factor in electric power industry's success in meeting all war-time demands . . . It was an acceleration of pre-war co-ordination practices . . . Utilities did it themselves, after OWU analyzed needs . . . Object: To get maximum use of existing facilities, minimize construction of additional facilities . . . Pacific Southwest region, an outstanding example, gained 385,000 kw by co-ordination . . . Some pooling techniques, good for emergency, not good for normal operation . . . Operating techniques . . . Future power pooling

By Edward Falck

CO-ORDINATED OPERATION of electric utilities in the United States is no "war baby." Prior to the war, American utilities led the world in the art of transmission interconnection and integrated operation of electric systems, both great and small. We hear a great deal about the British transmission grid but every American utility operator can think of many interconnected American systems which, prior to the war, far exceeded in both capacity and area coverage even the war potential of the British system. The story of power pooling in the United States during the war, therefore, is not one of developing a new art as in the case of radar, penicillin or the atomic bomb. Rather, it is the story of a tremendous acceleration in the application of the art of high-voltage transmission and of inter-system co-ordination. The change was in response to the urgent national necessity of the times—the shortages of materials, of shop space and of manpower and the need for diverting national productive energies to war. In the critical years 1942 and 1943, even had other factors permitted, the factor of time alone would have made it impossible to increase generating capacity in step with the mounting loads.

Pre-War Power Pooling

Before Pearl Harbor electric utility interconnection was the product, for the most part, of mutual benefit. Many interchange contracts were based on the economic gains from utilizing diversity between peak loads, from staggered construction, from co-ordination of seasonal hydro plants with steam stations and from fuller utilization of more efficient steam stations. In some cases, particularly between systems with common ownership, these advantages were being fairly effectively exploited. Business economics from the standpoint of individual management were not the controlling factor in the creation of the great power pools which were put together during the war. The emphasis, during the war period, was to assure the maximum co-ordinated use of existing facilities and to minimize the amount of additional generating capacity required to carry war loads.

Southeast Was the Pilot Operation

The "pilot plant" operation that was the grand-daddy of all regional power pools was worked out in the latter half of 1941 in the Southeast as a result of the drought which threatened power supply in that area. The utilities had built a large amount of transmission interconnection before the war but co-ordinated operation on a regional basis was not generally practiced. Conditions in the area deteriorated during the summer of 1941 due to an abnormal lack of rainfall. Despite a considerable increase in the amount of interchange, by the fall of 1941 it became necessary for the newly organized Power Branch of the Office of Production Management to step in with drastic action to bring about full co-ordination of the utility operations in order to prevent delays and interruptions to national defense and Lend-Lease production. The instrumentality through which this was done was Limitation Order L-16 which directed the utilities in the affected area to operate their systems so as to maximize the flow of energy into the systems of the Tennessee Valley Authority and the Commonwealth and Southern Companies. A field office was established in Atlanta by the Power Branch and during the period of the drought the Power Branch supervised load dispatching over the entire area. This overall dispatching increased the flow of energy into the drought stricken region from about 30,000,000 kwhr to over 42,000,000 kwhr per week.

Out of this experience grew Limitation Order L-94 which was first issued on May 1, 1942, and which until the Japs succumbed in August, 1945, provided the governing legislation for wartime utility co-ordination. Order L-94 had three purposes:

1. To direct the most effective interconnection and co-ordination between utility systems in each power supply area;
2. To require the maximum use of all existing facilities when needed to maintain regional power supply; and
3. To provide procedures for curtailment of less essential loads in the event of a power shortage.

Curtailment Provisions Never Used

A major achievement of the utilities of this country is the fact that the curtailment provisions of Order L-94 never had to be used. The one industry which was most frequently singled out, before the war, as the weak link in America's ability to produce munitions stands today as the one industry which, through the war, met every requirement placed upon it.

Utilities Did It Themselves

This record was accomplished in large part by integration and co-ordination. Moreover, the utilities have done the job themselves. The Office of War Utilities has not found it necessary to issue specific integration directives or to maintain a staff of engineers and dispatchers for the purpose of controlling utility operations. Instead, the utility systems have arranged their operations to fit the policy set forth in the order to the extent necessary to prevent power shortages and to minimize service interruptions. All that has been required of the Office of War Utilities has been to identify needs and relative urgencies, to suggest desirable wartime practices and, in some cases, to take the initiative in bringing operating officials together.

The Office of War Utilities was forced, because of the shortage of materials, to consider all problems of power supply on a regional basis rather than in terms of individual systems. Most of these regions al-

ready were partially interconnected and capable of co-ordinated operations before the war but in many instances these facilities were not generally used to the fullest extent possible. The biggest of these groups of utilities which were partially co-ordinated at the outset of the war were those in the New York-New England area, the Pennsylvania-New Jersey-Maryland area, the Southeast, the East Central, the Southwest, the Pacific Southwest and the Pacific Northwest. These pools varied in size from 3,000,000 kw to 11,000,000 kw and in area extended over from three to eight states. To a very useful degree, the East Central, Southeast and Southwest pools operated as a super-pool with over 21,000,000 kw of resources.

Progressively, as the war economy developed and materials, shop space and manpower shortages became increasingly acute, the individual utility systems in these areas were "forced" into increasing dependence upon each other. Normal peace time reserves were cut by about one-third as a matter of deliberate policy in order to minimize the amount of new generating capacity to be authorized in competition with the Naval and ship-building construction programs. This slashing of reserves was done with full knowledge that normal maintenance and rehabilitation of equipment could not be carried out, and that, as a consequence, in a very real sense current generating capacity needs were being met by borrowing from the future. That these borrowings must be repaid has already been shown during the past 6 to 12 months by the rapidly increasing forced outages of equipment.

Pacific Southwest an Outstanding Example

An outstanding example of how the co-ordination and integration of operations and the planning of power supply to meet expected war loads for a given area is the story of the Pacific Southwest. Prior to the war, the electric utility systems in California and those in Nevada and Arizona practiced some interchange but no real area co-ordination of operations had been developed. As was true with many of these war area power pools, the primary impetus for co-ordination in the Pacific Southwest came from the need to provide quickly for tremendous new industrial loads, particularly the 200,000-kw load for the magnesium reduction plant which it was determined to locate at Las Vegas, Nevada.

In March, 1942, a representative of the Power Division was sent to California to survey power resources and expected loads and to recommend the necessary steps for adding new capacity and integrating both existing and new capacity so as to obtain maximum utilization of all facilities in the area. Co-ordination of the utility systems in this area was complicated by the fact that the Southern California Edison system operates at 50 cycles while all of the other systems, except the Salt River Valley Water Users' Association in Arizona, operate at 60 cycles. Before the war, the interconnection facilities between the 50 and 60-cycle systems were definitely limited and there was very little interchange of energy. The Power Division survey quickly made clear that if the area could be operated on a co-ordinated basis, a substantial amount of power could be made available for carrying new loads without either the time lag or the drain on materials required to produce and install an equivalent amount of new generating capacity. A considerable portion of the available surplus was on the 50-cycle system.

On the basis of the survey findings, the Power Division developed a program for co-ordinated operation of the utilities in the area and a meeting was held in Los Angeles on May 21, 1942, at which the necessary steps were outlined and agreed to. At the same time, an operating committee was set up by the utilities to carry out the program and later a special task committee was organized to work out day-to-day operating problems.

Pacific Southwest Co-ordination Gained 10%

As a result of the agreement of the utilities at this meeting to co-ordinate their operations, a gain of 385,000 kw in capacity was realized in an area with a total load of 3,750,000 kw. This was made up as follows:

Savings in operating reserves	190,000 kw
Increased loading Boulder-Los Angeles 287,-000-kw transmission lines	55,000 kw
Co-ordinated maintenance	30,000 kw
Arizona California co-ordination	30,000 kw
Fully loading Boulder Unit A-8	20,000 kw
Operation of hydro units in Owens Valley	10,000 kw
System diversity	50,000 kw
Total	385,000 kw

It should be pointed out that agreements reached on reserves were on a wartime operating basis and probably could not be realized during peace time. Prior to the war, the City of Los Angeles had set an operating limit of 425,000 kw total for its three 287,000-kw Boulder lines. It was agreed that they could safely increase this load to 480,000 kw and studies which they carried out later confirmed this conclusion.

Utility Co-operation Did the Trick

In formulating and carrying out the co-ordination of these systems, the utilities in this area deserve the highest praise. Because of the many complications, a great deal of co-operation among the utilities was required to solve both the policy and operating problems. The City of Los Angeles, for example, under its charter could interchange energy only on a very

THE AUTHOR

EDWARD FALCK has played a major part in the development and administration of the war utility program since before Pearl Harbor. He has been Director of the Office of War Utilities for the last sixteen months and before that had been its deputy director since its creation. He was largely responsible for the power rationing program worked out for the Southeastern curtailment late in 1941, out of which grew Order L-94 and others.

In addition to directing the domestic war utility program, Mr. Falck has had direct charge of the OWU work assisting the Army in planning for installation of equipment in occupied and recaptured countries. Under his direction, also, OWU sponsored a team of utility technicians in search of German "know how" of value to us.

For more than a year during the development and early administration of the CMP, Mr. Falck also was assistant priorities director of the WPB under J. A. Krug, the first OWU Director and now WPB Chairman. Mr. Falck came to Washington from the position of assistant to John Parker, vice president of Consolidated Edison Co., to help Mr. Krug organize the Power Branch in the old Office of Production Management in 1941. Before joining Consolidated Edison, Mr. Falck had been Director of Rates and Research for the TVA. He is a graduate of Columbia University—AB, 1930—and of Columbia School of Engineering—MS in industrial engineering and public utilities—and was a Columbia University Fellow in 1932 and 1933.

As of September 30, 1945, the OWU has gone out of existence and Mr. Falck planned to open a utility and industrial consulting firm in October, with offices in New York and Washington, specializing in utility and industrial management and public relations.

small scale. At their request, the Office of War Utilities sent them a letter urging them to co-operate fully in the co-ordination program during the war. This was done to the fullest extent and contractual relations worked out with the Edison Co., San Diego, California Electric Power Co. and the Burbank, Pasadena and Glendale municipal systems. Fortunately, during the war, water conditions were such that the lowering of reserves to war-time limits and the full extent of interchange were not required. However, beginning with the early part of 1945, with the impending fuel oil shortage, every possible step was taken to save generation in fuel-burning plants and during this period maximum interchange was practiced throughout the system.

Sometimes New Facilities Were Needed

The additional physical facilities required to effectuate these co-ordination arrangements in the Pacific Southwest were relatively not great. In some other regions, however, they were substantial. For instance, in the East Central pool, supplying the major concentration of war-fabrication industries, about 1,500 miles of new high-voltage, high-capacity transmission lines were required to strengthen the internal network and to interconnect via the Tennessee Valley Authority system with the Southeast pool. With this strong network and modern load control practice, it is now a common occurrence to find, within relatively short periods, load shifts of 50,000 kw to 150,000 kw between different parts of the region or between this region and the Southeast region.

On one occasion, due to internal trouble in a major generating station, 300,000 kw was automatically picked up by other stations in the network without any loss of load. On another occasion in the Southeast region, 300,000 kw of generation was lost without loss of load, 200,000 kw of the pickup being in the East Central network. Such instances, while of unusual proportions, are excellent illustrations of what is accomplished by pooling of reserves; not alone saving of generating capacity but actual improvement of emergency protection.

Similarly, in the Southwest region considerable strengthening of the intra-region network was required. In this region, new war loads were added from time to time which were very heavy in proportion to local resources — explosives plants, oil-pipeline pumping in large amount, oil refineries and rubber plants, aluminum and magnesium. At different stages in the war program, dangerously stringent power conditions have arisen in south Texas, in north Texas, in Arkansas and in eastern Kansas. That all have been successively met was due to the utmost degree of co-ordination in resources over this wide area and to the flexibility afforded by the internal transmission network. At times heavy imports were made from the Southeast pool, at other times flow was reversed into the Southeast.

Not All War-Time Practices Good for Peace

This type of co-ordination, however, has for many systems involved practices which they would not wish to continue indefinitely and which they often would not wish to set up as voluntary precedents by continuing them on their own initiative without a government order. Load dispatching methods, relay settings, line loadings, assignment of spinning reserves, rotation of maintenance, rule curves for hydraulic reservoirs, and other operating practices have been set up for best overall protection, but often at the expense of increased service hazard or impaired service quality or added operating cost to an individual system. Standby protection, unbalanced or wholly one way, has been given without charge, contractually secondary service has been treated as primary, energy has been transferred without transmission charges. Scanty coal stocks have been drawn on for protection of others facing more immediate trouble. Operating officials and load dispatchers have been given free rein in arranging inter-company transactions which formerly would have gone back to top management.

Operating Techniques

The actual mechanics of operating these pools has varied widely throughout the war, ranging from groups like the Pennsylvania - New Jersey area with a central dispatching system to others having a very loose and informal consulting arrangement. The Pennsylvania-New Jersey central dispatching organization was in operation long before the war and its work was merely intensified. In the East Central region, a top operating committee was formed for the region comprising Indiana, Ohio, West Virginia, Kentucky and the western parts of Pennsylvania, and Virginia, with four area operating committees under the top committee. A less formal operating committee was constituted for Wisconsin and Northern Illinois. In the Southwest, a top steering committee met at intervals, with a number of area operating committees meeting frequently, and a substantial degree of central dispatching was adopted. In the Pacific Northwest, an operating committee was organized and normally held meetings once a month. A smaller co-ordination committee was set up in Portland, Oregon, to direct the policies formulated by the operating committee.

However, neither the operating committee nor the co-ordination committee handled actual dispatching but rather sponsored weekly telephone conference calls with all the participating officials and, in addition, received weekly reports from which to check actual against programmed operation. In other regions it was not even necessary to set up a formal operating committee; responsible executives in each of the utilities working in co-operation with the Office of War Utilities were able to carry out the necessary co-ordination throughout the operating departments of their respective systems.

Power Pooling in the Immediate Future

What about power pooling in the period that lies ahead? For the immediate future, most if not all of the co-ordination which was necessary during the war will remain important. With the easing of materials and shop capacity last spring as the war in Europe neared an end, the Office of War Utilities authorized some 2,000,000 kw of additional generating capacity for installation in 1946 and 1947, most of which was intended to restore the utilities to a more normal reserve position. Not until 1947, however, will utilities generally have installed and operating the margin of spare capacity necessary to permit the pre-war degree of freedom of individual operation.

After that, however, economics must inevitably again become the basis for determining the extent of co-ordinated operation. When that time arrives, some of the practices which have been in effect for the last three or four years will be scrapped —operation of inefficient and relatively high-cost equipment, unbalanced standby production and transferral of energy without transmission charges are likely examples. By the same criteria, however, we may expect a continuation and expansion of such interchange operations as permit rotation of maintenance, pooling of reserves, co-ordination of hydro and steam, staggering of construction and similar practices, which the war experience has shown to be valuable both dollarwise and in strengthened service.

Qualities of Amine

(Continued from page 82)

NaOH produced a greater abundance of the free ammonia vapor.

Conclusions from the foregoing tests show:

That the amine, although condensable with water vapor (steam), will undergo decomposition which will be stimulated by the presence of a caustic as found in boiler water;

That a minimum of 2.3 per cent of the amine concentrate will be lost per hour in the condensate system;

That the presence of amine in the condensate will lower the resistance to such a degree that it would be difficult to determine any contamination of raw water in the condensate by condenser leakage; and

That although the pH value of the condensate may be increased, the decomposition of the amine to free ammonia may increase corrosion of iron and render any copper and/or its alloys more soluble in the amine-treated water.

A Calibration Method for Electrodynamic Power Factor Meters

By Paul MacGahan

Meter Engineer, Westinghouse Electric Corporation
Newark, N. J.

THE USUAL construction of the moving coil electrodynamic type three-phase power factor meter consists of a moving element having two voltage coils crossed in position and permanently attached to the movable shaft, and a single stationary current coil. Having only a current coil, energized by one-phase, the instrument is correct only under balanced load conditions. The currents from two of the three-phase voltage leads are conducted through permanent non-inductive resistors to the moving coils by means of very thin conducting springs, so designed as to have as little torque as possible. Thus, practically all the control forces acting on the movement are electrical, consisting of electromagnetic torques between the moving coils and the stationary coil. The "restoring torque" which directs the pointer to a scale reading is equal to the difference between the two opposed torques between the stationary current coil and the two crossed-voltage coils. Therefore, when current and potential are applied to the instrument from a three-phase line, the system will turn until the torque between the stationary coil and each of the crossed moving coils become equal. Figure 1 is a schematic diagram of such an instrument, together with its connections to a three-phase system; A, being the current coil; B and C the moving coils; D and E the internal resistors.

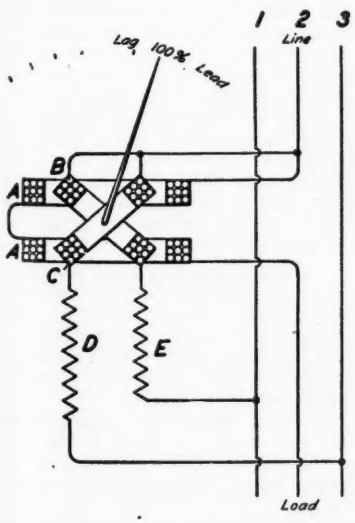
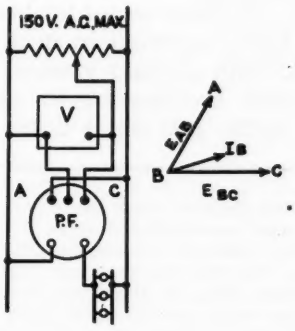


Fig. 1. Schematic diagram of electrodynamic three-phase power factor meter. A, the current coil; B and C the moving coils; D and E the internal resistors



THREE PHASE 100 DEGREE SCALE P.F. METER CALIBRATED BY VARIABLE VOLTAGE METHOD. (POTENTIOMETER-RHEOSTAT OF 1000 OHMS MAY BE USED).

Power Factor Scale	Voltage Settings % of Normal Volts	
	Coil AB	Coil BC
100	100.0	100
90 Lag	56.2	100
80 Lag	39.6	100
60 Lag	13.1	100
50 Lag	0	100
30 Lag	-28.9	100
20 Lag	-47.3	100
90 Lead	100.0	56.2
80 Lead	100.0	39.6
60 Lead	100	13.1
50 Lead	100	0

Fig. 2. Calibration table and wiring diagram for variable voltage method of calibrating power factor meter

A common construction is to attach the pointer at an angle bisecting the angle between the movable coils, in which case the 100 per cent power factor point is at the center line of the scale. However, the pointer may be set at another angle when it is desired to have the 100 per cent scale point at another position, so as to allow the scale to be marked to a lower extreme value for lagging than for leading power factors. The usual method of calibrating such power factor meters is to compare their readings with an ammeter, voltmeter and wattmeter on a balanced three-phase circuit according to the relation.

$$\text{Power Factor} = \frac{\text{Watts}}{\text{Volts} \times \text{Amperes} \times \sqrt{3}}$$

A much simpler and more convenient method is afforded by the use of variable applied voltages permitting calibration to be accurately performed on a direct or single-phase alternating current circuit.

To understand this method, consider first the action of the instrument when placed on the usual three-phase a-c circuit. Assume that the power factor is unity. The current in coil A is in phase with the current in the line 2. The current in coil C is in phase with the voltage across the phases 2-3 and thus lags 30 deg behind the current in coil A. The current in coil B gets its voltage from lines 1 and 2 and thus leads the current in coil A by 30 deg.

The torque between the stationary coil A and either movable coil B or C, is proportional to the ampere-turns in coil A times the ampere-turns in coil B (or C), times the sine of the mechanical angle between coil A and coil

(Continued on page 94)

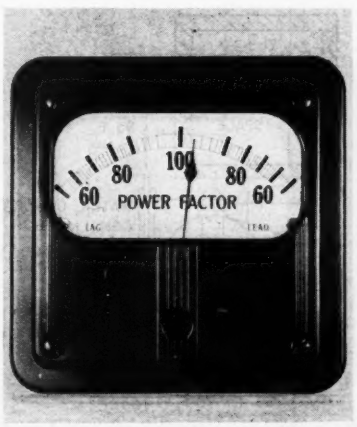


Fig. 3. A switchboard-type power factor meter

How Small Refrigeration Plants Can Operate with Less Water

They may be forced to do so . . . A little 1-hp Freon-12 unit will require 15 cu ft of water per hr on the average . . . Multiply this by the number of such small units in use and you see why, in view of the tremendous expansion of refrigeration and air conditioning ahead, many cities may prohibit direct use of water for refrigeration operations . . . Falling water tables and water supply difficulties have been reported in many cities . . . Here's what you can do with cooling towers, evaporative condensers and air-cooled condensers to reduce water consumption in small units, just as is done in the big commercial units

By

W. E. Patten

A REFRIGERATING MACHINE, as all engineers know, whether a large plant or your kitchen refrigerator, makes one space cold by removing heat energy from the space and giving off this heat energy to warm up some disposable medium, such as water or the surrounding air, as in the case of the usual household refrigerator.

At the heat inlet end of the apparatus, we have a cooling element or evaporator that becomes cold and at the heat outlet end there is a heat-dissipating element or condenser, which becomes hot, comparatively speaking. For reasons of simplicity and low installation cost, most early refrigerating machines were water cooled. This is still generally true today for commercial machines of from 1 to 10 hp such as are used by grocery and meat stores, soda fountains, taverns, small dairies, small shop air conditioners, and the like.

Direct Water-Cooled Condensers

A simple form of water-cooled condenser, Fig. 1, used by many such machines, consists of two pieces of copper tube or steel pipe, one piece of smaller diameter than the other. The smaller tube is placed inside the other and suitable connections provided so that the hot gas from the compressor flows in the space between the tubes and the water flows in the inside tube only. In this manner, the heat from the gas is carried by conduction through the wall of the inner tube and is transmitted to the water without mixing with the water in any way.

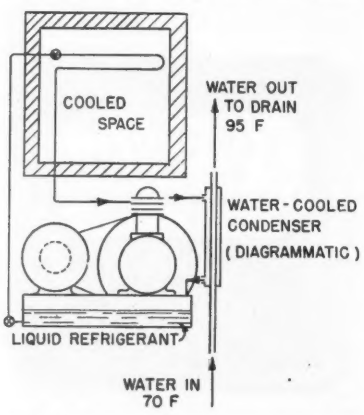


Fig. 1. Diagrammatic arrangement of small refrigeration unit employing a water-cooled condenser

The flow of water through the condenser is usually regulated by a modulating control valve operated by the compressor discharge pressure, to increase or diminish the flow as needed and to shut off entirely when the compressor stops. A magnetic valve can be used that opens when the motor starts and closes when the motor stops without providing any regulation as to variation of flow.

How Cooling Water Is Wasted

All too frequently, these water control valves are not kept in repair, with the result that water continues to flow from city main through condenser to sewer, day and night, in as large a stream as the piping can deliver.

If there is a meter on the water supply, the situation is usually brought to the owner's attention in the form of an abnormally high water bill. But many communities do not have water meters and this waste of water goes on indefinitely. In the past few years, with the installation of increasing numbers of water cooled refrigerating machines, and even where they are kept in proper repair, the water consumption in most cities has increased to the danger of exhausting all available supply.

Practically no large refrigeration plants use water for this direct cooling unless they have their own wells or can pump it from a nearby stream where the summer water temperature does not exceed 75 F.

Many cities have passed laws requiring clean water from refrigeration condensers to be discharged into storm sewers to avoid increasing volume of sanitary sewage. But in the next few years, we are going to find most cities prohibiting the direct use of water for operation of any refrigeration apparatus. If this is not done, there will not be enough water for other needs. Only abnormally abundant rainfall has prevented a severe water scarcity in eastern cities for the past two years.

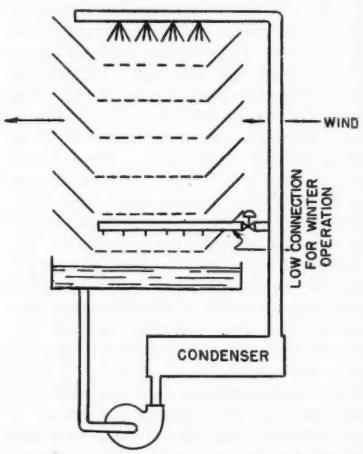


Fig. 2. Diagram showing how water is cooled by a natural draft cooling tower

Water Required by Small Units

To get some idea of this consumption of water by refrigerating machines, let us consider a 1-hp Freon—12 condensing unit, which could be about the size used by a small butcher shop or tavern.

The Btu output of a machine of this size would be about 10,000 Btu per hr plus the Btu equivalent of its motor power consumption of some 1.5 kw.

The heat required to be dissipated by the condenser per hour would be

$$10{,}000 + (1.5 \times 3415)$$
$$= 10{,}000 + 5123 = 15{,}123$$

or in round numbers 15,000 Btu per hr.

Minimum water consumption in cold weather, with water entering at 45 F and leaving at 95 F would be

$$\frac{15000}{95\text{-}45} = \frac{15000}{50} = 300 \text{ lb per hr}$$

or $\frac{300}{62.5}$ or approx. 5 cu ft per hr

In hot weather, with water entering at 75 F and leaving at 90 F, consumption would be

$$\frac{15000}{90\text{-}75} = \frac{15000}{15} = 1000 \text{ lb per hr}$$

$$\frac{1000}{62.5} \text{ or } 16 \text{ cu ft per hr}$$

Actually, these figures are a theoretical minimum; in practice they will run at least 50 per cent to 100 per cent above these calculations. Take 15 cu ft per hr as an annual average water rate with 15 hr per day machine operation. This will represent 15 × 15 × 365 or 82,110 cu ft per year. At a cost of $1.20 per 1000 cu ft, this means a water cost of $98.53 per year. An average home of a family of four, may use for general purposes, including lawn sprinkling, 8000 cu ft per year. On this basis here is a comparatively small machine using as much water as 10 families.

Now the issue that every owner of commercial refrigerating and air conditioning equipment is likely to have to face is, how can this equipment be kept in operation when the municipality denies the direct use of water?

The Cooling Tower

The plant of, say over 25 tons that operates all year, has already found the answer in the cooling tower. The condenser water is pumped to the cooling tower, usually located on the roof, where the stream is passed through nozzles and baffles to break the water into many droplets and thereby expose as much surface as possible to the surrounding air.

The water is first cooled by contact with the cooler air and secondly by the process of evaporation. The only water consumed will be that required to make up loss by evaporation and windage (water blown out of tower by wind). See Figs. 2 and 3.

Cooling towers fall into two classes with characteristics as follows:

A. Natural draft tower
   1. Depends on wind alone for air movement.
   2. In period of no wind and high humidity may become inoperative and require system to switch to city water for short periods.
   3. Requires large roof space.
   4. Difficult to ornament or work into building architecture to give pleasing appearance.
   5. Periods of high wind may blow great quantities of water out of tower which can become basis for damage claims from nearby property owners.

B. Forced draft cooling tower
   1. Uses power driven fans for air movement with consequent power cost.
   2. Requires much smaller roof space and weighs less than natural draft tower of similar capacity.
   3. Easy to conceal from view by incorporating into building design.

General Characteristics of Cooling Towers

1. Capacity of both types of cooling towers can be regulated for cold weather operation by:
   a. Introducing water at lower level.
   b. Reducing fan capacity in forced draft type.
   c. Having tower constructed in independent sections to allow any section to be cut out of operation.
2. Due to the amount of piping and quantity of water involved in a cooling tower system, the mass or flywheel effect is great. Consequently a sudden change in outside air temperature may not reflect much change in condensing pressures for several hours. This some times means that head pressures will stay within satisfactory limits during spring and fall when outside air temperatures may vary widely between day and night temperatures.
3. As with all types of water-saving equipment, cooling towers require their share of maintenance.
   a. Periodic draining and cleaning.
   b. Chemical treatment to reduce algae formation and muck.
   c. Careful supervision in freezing weather, to prevent ice formation. Many tons of ice can collect on a tower in a few hours of severe freezing weather and become of sufficient weight to break down tower structure or even the building roof itself.
4. Each pound of water evaporated from the tower system takes up approx. 1000 Btu. This would mean that one pound of water evaporated has the cooling effect of using 100 lb of city water raised from 70 to 80 F. By this it would appear that the water saving by cooling tower would approach 99 per cent which is far from true in practice, where saving of water is usually 85 to 95 per cent.

This water saving does not represent comparable cost saving by any means, because power consumption of auxiliary pumps and fans will at least be 10 per cent that required by the compressor drive. Also cooling tower and pump system represent definite cost which must be charged off on depreciation basis.

Evaporative Condensers

Evaporative condensers are also sold as "economizers" and "water savers."

In this unit of apparatus are combined the functions of condenser and cooling tower, so that the regular condenser can be omitted unless desired for stand-by equipment.

Sometimes the liquid receiver is also mounted inside the evaporative condenser, where it is desirable to sub-cool the liquid refrigerant. See Fig. 4.

The condenser is usually a bundle of bare copper tubes or galvanized steel pipe encased in a housing. Water from a circulating pump is sprayed or cascaded to continuously flow over the coil, falling into an open pan or tank for recirculation. Usually a float valve in this tank admits water to keep level constant. Fans above the coil draw air through the coil and the spray water and tend to cool the spray water to approach the wet bulb temperature of the incoming air. In this manner the water acts as a transfer medium to take up heat from the condenser tubes.

Evaporative condensers are manufactured in sizes ranging from 1 to 100 tons capacity.

Small size units sometimes omit the circulating pump by using some kind of slinger disc on fan shaft, or by spraying water on coil with spray nozzle operated by water at city pressure and controlled by conventional automatic water regulating valve. This latter scheme achieves simplicity and freedom from maintenance but uses much more water as water passes over coil but once and then drains to sewer.

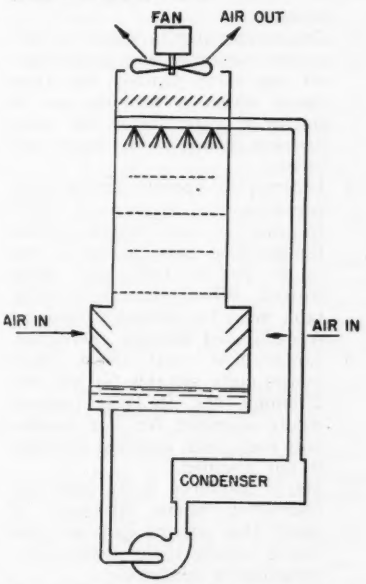


Fig. 3. Diagram of cooling tower with fan for producing draft

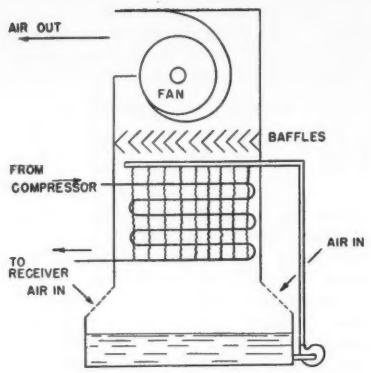


Fig. 4. Diagrammatic arrangement of evaporative condenser

Some manufacturers make their evaporative condensers identical with their unit coolers so that except for accessories, they are the same, coil section, fan, tank, etc.

In general, evaporative condensers save about the same amount of water as cooling towers, the saving being 85 to 90 per cent over that of a direct water-cooled condenser. Pumping costs of circulating water will be much less for evaporative condenser than for tower system due to comparatively short distance water has to travel.

General Characteristics of Evaporative Condensers

1. Can be installed outdoors or indoors with ducts to secure outside air.
2. Need not be placed on roof but proximity to ground usually means more dirt in air and need of more frequent cleaning.
3. Capacity can be reduced by dampers to vary air delivery of fans either manually or automatically operated, but the latter means more complex apparatus.
4. Can be operated in winter as air-cooled condenser with pump shut off and sump drained, but then there arises a problem as to source of water supply for compressors having water-cooled cylinders.
5. Difficult to operate where temperature goes above and below freezing in few hours. When temperature goes up, water has to be put in tank and pump started. When temperature falls, tank must be drained to prevent freezing and damage therefrom.
6. Lower first cost than tower makes quite suitable for air conditioning, etc., in large tonnage where operated for few months only each year, and cost of tower is not justified.
7. Many instances have been encountered where operators of plants that operate daily all year prefer cooling tower system over evaporative condenser.
8. When plant is in constant operation and evaporative condensers are indicated, stand-by units should be installed. For instance a 20-ton plant should use 3—10-ton units.
9. At least weekly draining of tank and washing out sludge is required, even where tank is allowed constant overflow to dilute dirt washed from air and dissolved salts.
10. In locations where water is high in dissolved salts, chemical treatment of water will be required and probable chemical cleaning of tubes to remove scale will be needed.
11. One incidental feature is noted: that evaporative condensers are the most efficient traps for Japanese Beetles ever devised. The insect enters the air intake and is drowned by the sprays. Wings and shards tend to clog pump suction screen. One single 50-ton condenser can process about 5 bushels of beetles per week during the beetle season.

Items Relating to Evaporative Condensers Needing Further Development

1. Circulating pumps:

   Where standard unit motor pumps are used these have to be placed outside condenser tank. This means providing separate drain for leakage at packing.

   Vertical motor pump units that are placed inside tank are too close coupled. Clogging of overflow submerges pump motor and in normal operation water or brine creeps up shaft to damage lower motor bearing. There is definite need for a good centrifugal pump similar in construction to the ordinary household cellar pump where motor is separated at least 12 in. from pump.
2. Fan drives frequently use short belts and belts are overloaded giving short life and frequent belt failure after working hours.
3. Fan shaft bearings very difficult to replace without damaging fans on designs where a bearing occurs between fans.
4. Fan bearing should have lubrication fitting extended outside fan housing.
5. Fan noise complaints from neighbors practically prevent the installing of present model evaporative condensers in residential neighborhoods.

When we realize that some answer is going to have to be found to operate refrigeration plants with less water, the evaporative condenser is the most likely answer for plants from 1 or 2 tons to 20 tons.

There is going to have to be more servicing done but it should not cost much more than the cost of water saved.

Small stores, taverns, etc., are going to have to find more space for the refrigeration apparatus because the evaporative condenser will occupy more space than the water cooled condenser and it will have to be accessible for service.

The greatest problem will be reduction of noise created by evaporative condenser fans. The noise level of currently produced apparatus is just too great to be acceptable in a residential neighborhood and has already resulted in retaliation by neighbors by law and otherwise.

Air Cooled Condensers

As was mentioned early in this article, the heat can be removed from a refrigeration machine by air provided air is available, preferably at less than 100 F. The condensing unit of most household refrigerators is cooled by this method. A common form of air-cooled condenser is a series of finned tubes resembling an automobile radiator core. The hot gas from the compressor discharge flows inside the tubes and air, from a fan, passes over the tubes to take up the heat.

Most all condensing units below ½ hp in common use are air cooled. Air-cooled condensing units with condenser mounted on compressor frame are generally available up to 3 hp. Two serious difficulties prevent general use of air-cooled refrigeration units as a water saving measure.

1. Heat from machine is discharged in same area as that occupied by employees and customers. The heating effect of even a household refrigerating unit is noticeable in a closed kitchen in hot weather.

The heating output of a 2 hp refrigerating machine would be some 30,000 Btu per hr which is about as much heat as that derived from burning 3 lb of coal per hour at 70 per cent efficiency. In hot weather, this additional heat is very objectionable.

One way to get this heat out of the building is to use separate air-cooled condensers mounted in windows where heat can be directed outside in hot weather and inside in cold weather. Duct work to bring in outside air and return it would accomplish the same result, but would increase the installation cost and the complexity of operation.

2. Variation of machine capacity with air temperature.

Due to fact that air cooled refrigeration compressors are expected to operate at higher discharge pressures than water cooled, an air cooled machine must be operated at lower compressor speed than a water cooled machine of same horse power. This means more horse power to do the same work with air cooled compressor and additional power cost.

One of the most common methods of controlling starting and stopping of refrigeration compressors for above freezing applications is by a pressure actuated switch connected to suction line or to evaporator. This permits coil to defrost each time compressor stops and keeps humidity high

enough to prevent serious weight loss of meats and vegetables.

With a water-cooled machine, discharge pressure can be held constant with result that capacity remains constant, and same control switch setting will usually serve for winter and summer.

With air-cooled machine, discharge pressure on Freon-12 can vary from 70 lb ga in winter to 180 lb ga in summer. This means a variation of from 85 lb absolute to 195 lb absolute, so that pumping capacity may be double in cold weather when load is possibly one half. This would result in a situation where, in winter, the compressor is four times too large for the job. The result is that compressor operates with a very short on-cycle and long off-cycle. Humidity in a meat storage box then goes so high that meat becomes sticky and bacteria multiply to start a high rate of spoilage and trimming loss.

It then becomes necessary to change pressure switch setting from a summer range on Freon-12 of 34 lb ga cut-in and 17 lb ga cut-out, to something like 31 lb cut-in and 12 lb cut-out in winter to secure longer running time and decrease humidity.

The use of two compressors of half size each, instead of one full size, will remedy the situation by shutting one off in winter. This is frequently done on locker plants, but for small stores the increased cost of installation will not ordinarily meet the purchasers approval.

The air-cooled refrigeration compressor is highly popular in sizes of ¾ hp and smaller, and there is no reason to believe that it will not continue to serve in this field.

The Hopes of Post-War Light Sources

By SAMUEL G. HIBBEN Director of Applied Lighting
Westinghouse Electric Corporation, Bloomfield, New Jersey

IN THE RESEARCH laboratories of Westinghouse there are among many of the problems receiving constant attention the very vital ones of transferring electrical energy directly to radiant energy without the intermediate step of heat. The objective is old, but several recent approaches are new. When this war began, some 95 per cent of the man-made light sources were tungsten filament lamps having their optimum economic light emission when the filaments were operated at a temperature of approximately 3000 deg. K, and whereof the heat losses were on the order of 90 per cent of the input energy. This did not seem good enough.

The commercial Mazda filament lamp with its efficiency of some 14 lumens per watt where 7.5 per cent of the input energy is converted into radiation to which the human retina responds, may well remain a standard article for household use and for small wattage local industrial lighting equipment but the urge for interior large-scale lighting and for illumination levels on the order of 50 to 100 footcandles demand that higher efficiencies be attained. How high are our hopes?

Romantically, the scientist turns again to studies of the firefly, of luminescent bacteria, and of chemiluminescence or bioluminescence in Nature. It is roughly estimated that 90 per cent of the radiant emission from a firefly is luminous, closely approaching 500 lumens per watt. This is ten times the ultimate efficiency that could be expected from a tungsten filament lamp since tungsten when melting at about 3655 deg. K could generate visible light at no better than 55 lumens per watt. If such a lamp were to burn for several hours, an efficiency of 35 lumens per watt would more correctly represent a practical top limit.

Like the firefly, most of Nature's lamps produce light by oxidation. No energy whatever is wasted in the production of invisible ultraviolet light and practically none in heat radiations. Man's latest lamps willy nilly generate much of both.

It appears that Nature's illuminants developed simultaneously with Nature's seeing organs. The luminous emission from a typical insect like the firefly is confined to a very narrow band of wave lengths, concentrated at the central point of the visible spectrum or at the light yellow-green color region (5700 A) where the response of the retinal nerves is most sensitive. Little or nothing is lost in emitting red or blue colors. By contrast, man's illuminants, particularly those of the hot body or incandescent types emit a great deal of light at the long wave and also the short wave ends of the visible spectrum and it is this radiation which, in addition to the infrared and ultraviolet, is generally wasted so far as seeing is concerned.

From a study of the color response characteristics of the human retina we might conclude that the sodium vapor lamp for instance which concentrates practically all of its luminous output at a wave length of 5890 A (lemon yellow) would be the best light source for general purpose seeing. However, a study of this and other almost monochromatic lamps indicates one further difference between Nature's illuminants and man's. The purpose of the latter is to make surrounding objects visible by light reflection therefrom, whereas Nature's lamps are primarily to be seen as signals, or markers, or lures. Man's seeing judgment depends to a large extent upon the color of the object being viewed and hence a monochromatic source with its resultant distortion of object color fails to meet our broad criteria for the ideal illuminant of tomorrow.

When we employ the energy of electricity to displace or excite the outermost electrons of the mercury atom within the commercial tubular fluorescent lamp thereby generating short wave ultraviolet radiations, and when this radiation in turn upsets the normal atomic arrangement of the phosphor crystals coated on the inside of the glass tube, we have achieved a "short-circuiting" light making process—i.e., we eliminate the production of much heat. By this method some 18 to 20 per cent of the input energy is converted to usable light. This still seems not good enough.

An arc discharge through high pressure mercury vapor ranging from 1 to perhaps 80 atmospheres (but commercially at about 3 to 5) develops luminous radiation at a commercial efficiency on the order of 65 lumens per watt. This is better—and further research will increase this efficiency in proportion as we can increase the temperature and pressure of the mercury vapor. The problem here is the refractory characteristic of the container. Summing up the situation we then have this analysis:

1. Tungsten filament illuminants now developing some 15 lumens per watt and practically limited to 35 or to a theoretical and ultimate maximum 55.

2. The fluorescent lamp, now developing some 45 to 60 lumens per watt and capable of doing roughly twice as well, as the technique of developing 2537A ultraviolet from mercury vapor and of efficiently exciting phosphor crystals therewith is perfected.

3. High pressure metallic vapor discharge lamps now producing 55 to 70 lumens per watt and theoretically capable of going considerably higher in efficiency if refractory containers could be had so as to permit increases in temperature that accompany pressure beyond roughly 5 atmospheres.

These, then, are some of the present day problems in lighting research that seem to offer a challenge to the engineer

What the Power Engineer Needs to Know About

THE FLIGHT CONVEYOR

By Wilbur G. Hudson

Consulting Engineer

What the flight conveyor is and how it works . . . How installed and operated . . . Controlled feed required . . . Costs of coal handling with this type . . . Tables of capacities . . . Calculation of power requirements

IN THEIR APPLICATION to boiler house coal handling, flight conveyors come into the picture for transferring the coal from ground level to a bin or bunker, and for distribution along the bunker. For the small plant the flight conveyor has the advantage that its cost is low. Larger plants prefer the belt conveyor, especially if the capacity is large.

Flight conveyors may have an upward inclination of 25 deg. If steeper than 30 deg the flights must be closely spaced since the coal tends to avalanche backward. The standard types are shown in Fig. 1.

Since the power required to drive a flight conveyor is the total of that due to the friction of the flights or chain upon the steel trough or guides, the coal upon the trough, and the power required to lift the load, if the conveyor is inclined, there is an advantage in types C and D if reduction in power is important. Often the substitution of rolling friction for sliding friction permits the use of a smaller motor and lighter chain. For very large conveyors, the carrying rollers are spaced between the joints or articulations so they can be renewed without dismantling the chain and are not subjected to the shock of the drive sprockets.

Controlled Feed Essential

Flight conveyors, like other mechanical conveyors and elevators, with the single exception of the continuous flow type, require a controlled feed. The usual types of feeder are: an inclined reciprocating plate, a slow-moving, deeply-loaded apron, a bar-flight feeder, which is a double-strand conveyor with narrow or bar-like flights, and the electro-magnetic vibrator, which has the advantage of no "moving" parts and ease of feed change.

An exception to the opening statement in above paragraph is that the bar-flight feeder, Fig. 2, can be extended to serve as a self-loading conveyor if the capacity is moderate and the lumps not too large.

Whatever the type of feeder, it is essential that it should stop when the conveyor stops. Sometimes this is assured by driving the feeder from the conveyor foot shaft, sometimes by interlocking the conveyor and feeder motors. Since the motors usually drive through a shear-pin as an instantaneous release in the event of jamming, the interlocking should provide for stopping the feeder motor when the conveyor motor is so released.

Comparative Costs

In the smaller steam plants, the total cost per ton handled with a simple unloading equipment will range

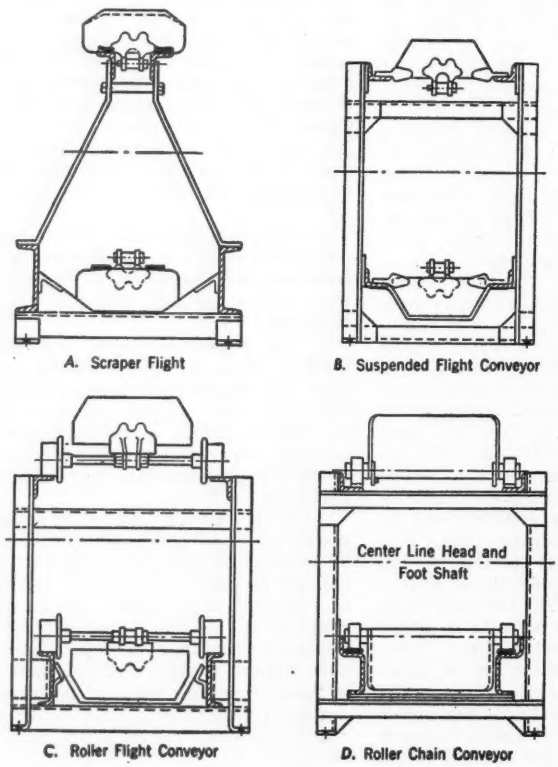

A. Scraper Flight
B. Suspended Flight Conveyor
C. Roller Flight Conveyor
Center Line Head and Foot Shaft
D. Roller Chain Conveyor

Fig. 1. Cross-sections through four types of flight conveyors

The flight conveyor consists of an endless chain or twin chains passing around sprockets at head and foot ends, with spaced transverse scrapers or "flights" attached to the chain and projecting into a trough, so that the motion of the chain causes the flights to push the material along the trough. Flight conveyors may be several hundred feet long.

In this drawing, A is a single-strand scraper flight conveyor, in which the flights are drawn along the trough bottom. B is a single-strand suspended flight conveyor with wearing shoes attached to the flights to carry them clear of the trough on the carrying run and support them along the return run. C is similar to the suspended flight conveyor except that rollers are substituted for the shoes—the roller flight conveyor. At D is shown the double-strand conveyor with roller chains to carry the flights—the roller-chain suspended flight conveyor.

The trough may be of forged steel plate or built up with channel sides and renewable steel plate bottoms. For corrosive material, the trough may be of cast-iron sections; for light materials (wood chips) it may be of hardwood planks.

Flights are steel plates or malleable iron with thickened edges. Wide flights of double-strand conveyors are reinforced with angles.

Drag chain conveyors do not have flights but their open links, running in a cast-iron or hardened-face concrete trough, serve to move the material.

from $0.35 downward, depending on the annual tonnage. This figure includes labor, power, upkeep, interest and a charge-off the investment in ten years. The labor cost is 3 or 4 cents per ton. So figured on the basis of total cost, a saving as compared with manual handling cannot always be shown. But while two or three men require a whole day to clear a car by shoveling, a track hopper and conveyor will do the job in two hours or so with one man—under normal conditions.

Capacities

Table I gives the coal handling capacities of several standard sizes of flight conveyors and the maximum lumps to which the conveyor is suited.

In Table II are listed the coefficients of friction of various materials. Some of these have so high a drag that the flight conveyor is unsuited to them. Thus it would not be used for wet ashes—not only for that reason alone but also because ashes are corrosive and abrasive.

The coefficient of friction of flights against trough, or flight shoes against guides, may be taken as 0.33 designated by F in the formulas below. If the guides are lubricated, F is reduced to 0.20. Roller friction coefficient is a function of the relative diameter of the pin and the roller, or—

$$RF = \frac{d}{D} \times 0.33 + 2\frac{Y}{D}$$

Where RF is rolling friction, d is diameter of pin, D is diameter of roller, 0.33 is the friction coefficient of steel against steel — roller bore against pin—and Y is the rolling friction of the roller against the track (0.03). As a rule, RF will approximate 0.1 unless the rollers are mounted on anti-friction bearings, when it is about 0.03.

Calculating Power Required

To determine the power requirement we first ascertain the chain pull. For a horizontal conveyor the pull is—

$$C_p = (2 \times W \times L \times F) + (W_1 \times L \times F_1)$$

Where C_p = chain pull or resistance to turning at the radius of head sprocket.
W = weight per foot of the sliding parts.
L = distance from head to foot shafts.
F = coefficient of friction for sliding parts.
W_1 = weight of material per foot of conveyor, or load per foot.
F_1 = coefficient of friction for material against trough.

If the element is carried clear of the trough by rollers, as in C and D in Fig. 1, the chain pull is—

$$C_p = (2 \times W \times L \times RF) + (W_1 \times L \times F_1)$$

If the conveyor is inclined, the down-hill pull of the return run of chain reduces the turning effort at the head shaft and therefore the power to drive, but does not reduce the chain pull. For an inclined conveyor, in which θ is the angle of slope, the turning effort with sliding element is—

$$(W \times L)\,[(\cos\theta \times F) + \sin\theta]$$
$$+ (W_1 \times L)\,[(\cos\theta \times F_1) + \sin\theta]$$
$$+ (W \times L)\,[(\cos\theta \times F) - \sin\theta]$$

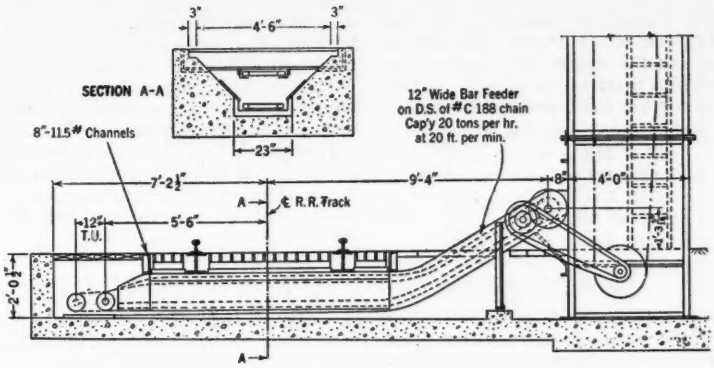


Fig. 2. Bar flight feeder and shallow track hopper

Table I. Capacities of horizontal flight conveyors handling coal and size of lumps handled

Flight Width and Depth inches	Amount of Material per Ft. of Conveyor, cubic feet	Approximate Capacity for 50-Lb Material at 100 Ft per min.,[1] tons per hour	Lump Size, inches (Lumps not to exceed 10% of total volume) Single Strand	Double Strand
12 by 6	0.40	60	3½	4
15 by 6	0.49	73	4½	5
18 by 6	0.56	84	5	6
24 by 8	1.16	174	—	10
30 by 10	1.60	240	—	14
36 by 12	2.40	360	—	16

[1] If the conveyor is inclined, multiply the horizontal capacity by 0.90 for 20° to 25°, by 0.80 for 25° to 30°, by 0.70 for 30° to 36°.

It is the pull required for the equivalent horizontal path plus that required for the lift. In a double-strand conveyor, each chain carries half the pull.

To illustrate the determination of power, let us assume a scraper flight conveyor for bituminous coal at 150 tons per hour, with path inclined upward at 23 deg and centers distance 150 ft. Assume the weight of chain and flights at 60 lb per lineal foot, and the weight of material in the trough at 50 lb per foot of conveyor. The coefficient of friction for the flights against the trough is 0.33 and in Table II for the coal, 0.59, so we have:

Turning effort in pounds
$= 9000 \times [(0.92 \times 0.33) + 0.39] = 6242.$
$+ 7500 \times [(0.92 \times 0.59) + 0.39] = 6996.$
$+ 9000 \times [(0.92 \times 0.33) - 0.39] = -778.$
Net turning effort = 12,460 lb

The return run is assisting the turning effort by 778 lb.

Motor Horse Power

For motor horsepower we use the net turning effort plus 10 per cent for friction in the head and foot bearings plus 10 per cent for loss in the reduction gearing plus 10 per cent (or more depending on the conditions for starting load or momentary surges. If we designate this as "gross turning effort," the motor horsepower is—

$$\text{Motor HP} = \frac{\text{Gross turning effort} \times \text{Speed in feet per minute}}{33{,}000}$$

We assumed that the material weighed 50-lb per foot of conveyor, and, since the capacity is 5000 lb per minute, the speed is 100 ft per minute. Thus—

$$\text{Motor HP} = \frac{16{,}583 \times 100}{33{,}000} = 50.25 \text{ (50-hp motor)}$$

Table II. Co-efficients of friction for various materials on steel plate

Anthracite coal	0.33	Hydrated Lime	0.65
Bituminous coal	0.59	Pulv. Limestone	0.60
Ashes, damp or wet	0.70	Magnesium chloride	0.70
Cement	0.93	Sand	0.68
Clay	0.60 to 0.70	Sawdust, wet	0.60
Coke	0.36	Soda ash	0.65
Copra (varies)	0.40	Starch	0.78
Grains	0.40	Sugar, fine gran.	0.67
Ground cork	0.65	Wood chips	0.35
Hog fuel	0.60		

Some of these materials would not be handled by flight conveyor, but they are grouped for convenient comparison.

The horizontal projection of the 150-ft centers is 138-ft. The lift is 58-ft and the weight lifted is the element plus material, or 60 + 50 = 110. Thus for the chain pull we have

C_p = Horizontal pull for element,
$60 \times 138 \times 0.33 = 2732$
+ Horizontal pull for material,
$50 \times 138 \times 0.59 = 4071$
+ Vertical lift,
$58 \times 110 = 6380$

Chain pull = 13,183 lb

This checks closely with the figure indicated by the total for turning effort without deducting the return run pull.

References: Don'ts for the Designer of Coal and Ash Handling Installation, by Wilbur G. Hudson, POWER PLANT ENGINEERING, Dec., 1943. Coal and Ash Handling in the Small Plant, by Wilbur G. Hudson: Ibid, Oct., 1944. Conveyors and Related Equipment, John Wiley & Sons, N. Y. Link Belt News contains frequent articles on the subject under discussion.

Electrodynamic Power Factor Meters

(Continued from page 87)

B (or coil C). The torque is also proportional to the cosine of the electrical angle between the current in coil A and the current in coil B or C.

In a three phase system connected as in Fig. 2, the electrical angles between coils A and B and between coils A and C becomes respectively $\phi + 30°$ and $\phi - 30°$ where ϕ is the angle of lag or lead of the circuit. It follows from the foregoing that we can write the equation of the torques of the instrument:

Torque coils A to B =

$I_a \times E_{ab} \times \sin ab \times \cos (\phi + 30°)$

Torque coils A to C =

$I_a \times E_{ac} \times \sin ac \times \cos (\phi - 30°)$

where I_a = current in line A, E_{ab}, E_{ac} = line voltages.

ϕ = angle of lag I_a to E_{ab}.

Connections within the intrument are made so as to have these torques work in opposition. The pointer has zero torque and comes to rest when the difference between these torques become zero or, $I_a \times E_{ab} \times \sin ab \times \cos (\phi \times 30°) = I_a \times E_{ac} \times \sin ac \times \cos (\phi - 30°)$.

This equation may be written:

$$\frac{E_{ab}}{E_{ac}} = \frac{\sin ac \times \cos (\phi - 30°)}{\sin ab \times \cos (\phi + 30°)}$$

from which it becomes apparent that the deflection of the moving system and pointer, at different power factors, can be represented by applying different ratios $\frac{E_{ab}}{E_{ac}}$ of the normal voltage to the two moving coils.

The accompanying tabulation shows the derivation and values of the voltage ratios which may be applied, corresponding to the power factors of the main scale points, column 1.

The method described is not applicable to power factor meters operating on the moving iron principle, such as the circular scale instruments, because the presence of iron introduces additional torques due to hysteresis and eddy currents when on polyphase circuits which are not present on single-phase or direct-current test circuits. These additional torques tend to rotate the movement in the direction of the phase sequence of the voltage coil circuits and are compensated by other means.

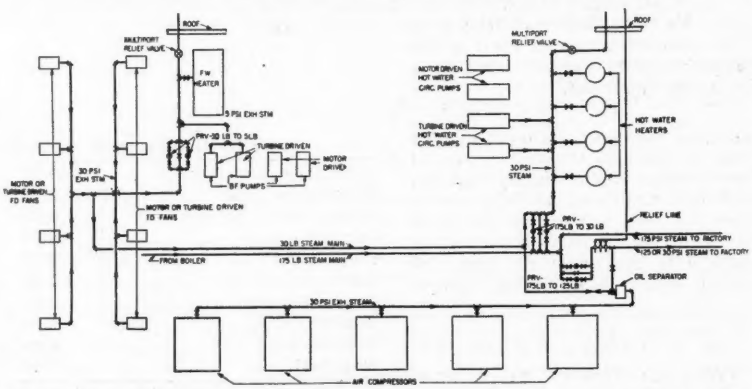
The applied current need not be measured accurately but should be between half and full load rating of the current coil, and should be non-inductive, as by a lamp-bank loading. The variable voltage supply may be obtained from either a variac, or a potentiometer-rheostat, or slide-wire resistance.

Progress in X-Ray Equipment

WILHELM ROENTGEN, discoverer of X rays, was born 100 years ago March 27, and exactly 50 years ago, November 8, he made his marvelous discovery of that wonderful ray which has since proved a boon to mankind and industry. Roentgen called his discovery X ray because he was at a loss to otherwise define this unknown quantity of great penetrating power. At the time, newspapers everywhere published stories, cartoons and even poems about the new "wonder rays." They printed ghastly skeletons of hands and feet of living persons and extolled the mysterious powers of these strange rays which could "see" through almost anything. Yet no one at that time dreamed that within half a century Roentgen's invention would be used by American industry in this war to build the toughest kind of fighting equipment—ships, airplanes, guns, tanks and even ammunition—to pulverize German cities, including Munich where the professor once carried on his research. Perhaps second to Roentgen in X ray development is that of Dr. W. D. Coolidge, who until a month or two ago when he retired, was director of General Electric's research laboratory in Schenectady. The Coolidge tube is world famous, used in hospitals and by industries all over the world. The husky glamor boy of industrial radiography today is General Electric's 1,000,000-volt shockproof unit. In 15 minutes it can inspect steel plates 8 inches thick. A year ago, General Electric announced an even larger X ray, one of two million volts, which will take pictures through 8 inches of steel in one minute. And two million is not the limit, for already Dr. E. E. Charlton and his associate W. F. Westendorf, also of G-E research laboratory, have perfected a 100,000,000-volt X ray but particulars of this giant are shrouded with secrecy until the war is over.

Steam Flow at Pratt & Whitney, Kansas City

One of the outstanding features of the Pratt & Whitney Aircraft Engine Plant at Kansas City, Mo., which was described in the leading article of the May issue, is the piping arrangement in connection with the utilization of exhaust steam from the boiler room auxiliaries and the steam driven air compressors. This system was described briefly by Mr. Choporis in his article but the accompanying diagram of the system which became available after the article by Mr. Choporis was published may be of further interest. As shown, the exhaust steam piping receiving steam at 30 psi from the forced and induced draft fans, boiler feed pumps, hot or chilled water circulating pumps and the five steam driven air compressors after passing through the oil separator, is connected to a common header. From this header exhaust steam is taken off to supply the feedwater heater at 5 psi through a reducing station. A large portion of the total available exhaust steam at 30 psi is utilized in the hot water converters during the heating season, for factory and office heating through a forced circulating hot water piping system which is also arranged to circulate chilled water during the summer season for air conditioning the vital factory and office areas.



Steam Flow Diagram at the Pratt & Whitney Aircraft Engine plant at Kansas City, Mo.

ATOMICS

A New Section added to POWER PLANT ENGINEERING to cover current and forthcoming developments in atomic energy and related developments and applications in Nuclear Physics

THE DEVELOPMENT OF ATOMIC ENERGY

The first of several articles giving a general account of the development of methods of using atomic energy for military purposes under the auspices of the United States Government. All the material in these articles is based upon the official report by H. D. Smyth, Chairman of the Department of Physics of Princeton University and a consultant to "Manhattan District," U. S. Corps of Engineers.

By Andrew W. Kramer, Managing Editor, Power Plant Engineering

IN AN ARTICLE in the September issue there was presented a brief history of atomic research and the events which led to the fission of uranium and to the transmutation of uranium 238 into plutonium. With these facts as background material the subsequent work as it was carried on in the Manhattan Project will now be considered.

By 1940 nuclear reactions had been intensively studied for over ten years. New techniques had been developed for producing and controlling nuclear projectiles, (neutrons, protons, etc.) for studying artificial radioactivity, and for separating sub-microscopic quantities of chemical elements produced by nuclear reactions. Isotope masses had been measured accurately and various relations governing the capture of neutrons by atomic nuclei had been measured. Methods of slowing down neutrons had been developed.

Also, the equivalence of mass and energy predicted by the Einstein equation had been proved. Einstein could hardly have foreseen the present applications, but as early as 1905 he did clearly state that mass and energy were equivalent and suggested that proof of this equivalence might be found by the study of radioactive substances. He concluded that the amount of energy, E, equivalent to a mass, m, was given by the equation

$$E = mc^2$$

where c is the velocity of light. If this is stated in actual numbers, its startling character is apparent. It shows that one kilogram (2.2 lb) of matter, if converted entirely into energy, would give 25 billion kilowatt-hours of energy. Compare this fantastic figure with the 8.5 kwh of heat energy which may be produced by burning an equal amount of coal.

Proof of the validity of this equation was first obtained by J. D. Cockcroft and E. T. S. Walton in 1932 when, by using high-voltage technique, they succeeded in producing nuclear changes in a target of lithium. By bombarding lithium with 700 kilovolt protons they found that alpha particles (helium nuclei) were ejected from the target as a result of the bombardment. The nuclear reaction which occurred can be written symbolically as follows:

$$_3Li^7 + {}_1H^1 \rightarrow {}_2He^4 + {}_2He^4$$

where the subscripts represent the positive charge on the nucleus (atomic number) and the superscript is the number of massive particles in the nucleus (mass number). In other words, the addition of hydrogen to lithium resulted in the formation of helium. The mass numbers were accurately known. On the left ($Li^7 + H^1$) they totalled 8.0241, on the right

This more or less detailed but at the same time general account of the Atomic Bomb Development is presented so that those who have a fundamental interest in matters of this kind will be able to explain some of the details of the development to their fellow citizens who perhaps do not have the capacity or inclination to learn the facts themselves. The ultimate responsibility for our nation's policy rests on its citizens and they can discharge such responsibilities wisely only if they are informed. As pointed out in Dr. Smyth's report, the average citizen cannot be expected to understand clearly how an atomic bomb is constructed or how it works but there is in this country a substantial group of engineers and scientific men who can understand such things and who can explain the potentialities of atomic bombs and atomic energy to their fellow citizens. This article and the others to follow is written for this professional group and is a matter-of-fact, general account of the work in the United States aimed at the production of such bombs. For the readers of Power Plant Engineering, the developments have, of course, additional significance, i.e., the use of atomic energy for power purposes. It is hoped that the details as disclosed here will stimulate thought in that direction and that in the end the real value of atomic energy will be in its use for power purposes.

($He^4 + He^4$) 8.0056, so it was evident that 0.0185 units of mass had disappeared in the reaction. The experimentally determined energies of the alpha particles were approximately 8.5 million electron volts each, a figure compared to which the kinetic energy of the incident proton could be neglected. Thus 0.0185 units of mass had disappeared and 17 million electron volts of kinetic energy had appeared. Now 0.0185 units of mass is 3.07×10^{-26} grams, 17 Mev is 27.2×10^{-6} ergs and c is 3×10^{10} cm per sec. If we substitute these figures into the Einstein equation, $E = mc^2$, on the left side we have 27.2×10^{-6} ergs and on the right side we have 27.6×10^{-6} ergs, so the equation is found to be satisfied to a good approximation. In other words, these experimental results prove that the equivalence of mass and energy was correctly stated by Einstein.

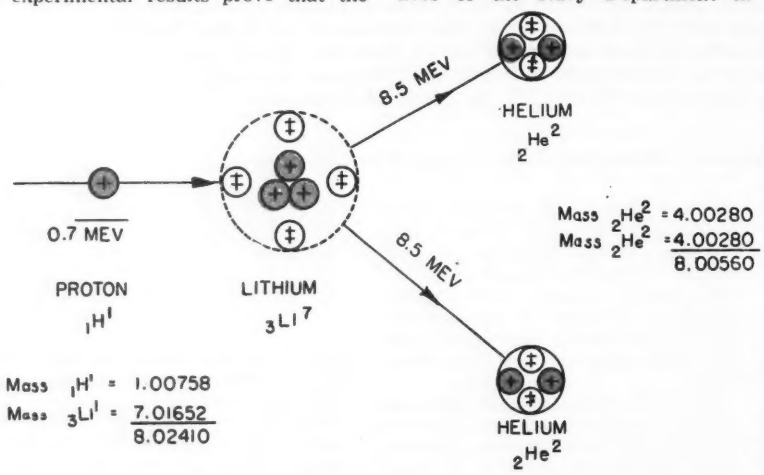


Fig. 1. Diagram showing the nuclear reaction resulting from bombarding lithium with 700,000 v protons

The implications inherent in the results of this experiment led to even more concentrated efforts in atomic research. In 1932, Chadwick in England had discovered the neutron and, having no electrical charge, this provided a powerful tool with which to get into the heart (nucleus) of the atom. Using it as a projectile, Fermi effected the transmutation of uranium into a new element which had atomic number 94 and which later was called plutonium. Then as a result of the work of Hahn and Strassmann in Germany in the latter part of 1938, the fission of uranium 235 was demonstrated early in 1939. This, for the first time, suggested the possibility of obtaining enormous energy release from atomic processes.

From the time that it first became evident that large amounts of energy might be released in nuclear reactions to the time of the discovery of the fission of uranium, the idea of atomic power or even atomic bombs was discussed on and off in scientific circles. The discovery of fission made this talk seem much less speculative, but realization of atomic power still seemed in the distant future and there was an instinctive feeling among many scientists that it might not, in fact, ever be realized. During 1939 and 1940 many public statements, some of them by responsible scientists, called attention to the enormous energy available in uranium for explosives and for controlled power, so that U235 became a familiar by-word indicating great things to come.

Looking back on the year 1939, we see that all the pre-requisites to the serious attack on the problem of producing atomic bombs and controlling atomic power were at hand. As a consequence, the possible military importance of uranium fission was called to the attention of the government and in conference with representatives of the Navy Department in March, 1939, Fermi suggested the possibility of achieving a controllable reaction using slow neutrons or a reaction of an explosive character using fast neutrons. By the summer of 1940 it was possible to formulate the problem fairly clearly, although it was still far from possible to answer the various questions involved or even to decide whether a chain reaction ever could be obtained.

The principle of an atomic bomb or power plant utilizing uranium fission was simple enough. If one neutron causes a fission that produced more than one new neutron, the number of fissions may increase tremendously with the release of enormous amounts of energy. It was a question of probabilities. Neutrons produced in the fission process may escape entirely from the uranium, may be captured by uranium in a process not resulting in fission, or may be captured by an impurity. Thus the question of whether a chain reaction does or does not go depends on the result of a competition among four processes:

1. Escape
2. Non-fission capture by uranium
3. Non-fission capture by impurities
4. Fission capture.

If the loss of neutrons by the first three processes is less than the surplus produced by the fourth, the chain reaction occurs; otherwise it does not. It was evident that any one of the first three processes might have such a high probability in a given arrangement that the extra neutrons created by fission would be insufficient to keep the reaction going. For example, if it turned out that process 2 (Non-fission capture by uranium) had a much higher probability than fission capture, there would presumably be no possibility of achieving a chain reaction.

An additional complication was that uranium contains three isotopes: U234, U235 and U238, present to the extent of approximately 0.006, 0.7, and 99.3 per cent, respectively. As has already been explained, the probabilities of processes 2 and 4 are different for the different isotopes—when U235 captures a neutron it results in fission; when U238 captures a neutron it results in the production of plutonium. Also, in the first case slow neutrons are involved, in the second case the process requires fast neutrons.

Neutron Escape; Critical Size

The relative number of neutrons which escape from a quantity of uranium can be minimized by changing the size and shape. In a sphere any surface effect is proportional to the square of the radius, and any volume effect is proportional to the cube of the radius. Now the escape of neutrons from a quantity of uranium is a surface effect depending upon the area of the surface, but fission capture occurs throughout the material and is therefore a volume effect. Consequently the greater the amount of uranium, the less probable it is that the neutron escape will predominate over fission capture and prevent a chain reaction. Loss of neutrons by non-fission capture is a volume effect like neutron production by fission capture, so that increase in size makes no change in its relative importance.

The critical size of a device containing uranium is defined as the size for which the production of free neutrons by fission is just equal to their loss by escape and by non-fission capture. In other words, if the size is smaller than critical, then—by definition—no chain reaction will sustain itself. In principle it was possible in 1940 to calculate the critical size, but in practice the uncertainty of the constants involved was so great that the various estimates differed widely. It seemed that the critical size might be too large for practical purposes.

As has been pointed out, slow neutrons have the highest probability of producing fission of U235 but it was also known that the neutrons emitted in the process of fission had high speeds. Evidently, it was an oversimplification to say that the chain reaction might sustain itself if more neutrons were created by fission than were absorbed. For the probability both of fission capture and of non-fission capture depends on the speed of the neutrons. Unfortunately, the speed at which non-fission capture is most probable is intermediate between the average speed of the neutrons emitted in the fission process and the speed at which fission capture is most probable.

For some years before the discovery of fission, the customary way of slowing down neutrons was to cause them to pass through material of low atomic weight, such as hydrogenous material. It was Dr. Fermi and L. Szilard who proposed the use of graphite as a velocity moderator for a chain reaction. It occurred to a number of physicists that it might be possible to mix uranium with a moderator in such a way that the high-speed fission neutrons, after being ejected from uranium and before encountering other atomic nuclei, would have their speeds reduced below the speeds for which non-fission capture is highly probable. It was clear that the characteristics of a good moderator were that it should have little or no tendency to absorb neutrons and that it have low atomic weight. Lithium and boron were excluded on the first count. Helium is difficult to use because it is a gas. The choice of moderator therefore lay between hydrogen, deuterium, beryllium, and carbon.

The general scheme of using a moderator mixed with the uranium was pretty obvious. A specific manner of using a moderator was first suggested in this country, so far as can be discovered, by Fermi and Szilard. The idea was to use lumps of uranium of considerable size as a lattice imbedded in a mass of moderator material. Such a lattice can be shown to have real advantage over a homogeneous mixture. As the constants were more accurately determined, it became possible to calculate theoretically the size and type of lattice that would be most effective.

Reduction of Non-Fission capture by Isotope Separation

Natural uranium, as has been indicated, is a mixture of three isotopes; U234, U235 and U238. Of these three, U235 is the only one that is subject to fission by the capture of neutrons. U238 also captures moderate-speed neutrons under certain conditions but in this case the nuclear reaction results in the production of Pu239, plutonium. There is also the probability of inelastic (non-capture-producing) collisions between high speed neutrons and U238 nuclei. Thus the presence of the U238 tends both to reduce the speed of the fast neutrons and to effect the capture of those of moderate speed. Although there may be some non-fission capture by U235, it is evident that if we can separate the U235 from the U238 and discard the U238 we can reduce non-fission capture and can thus promote the chain reaction.

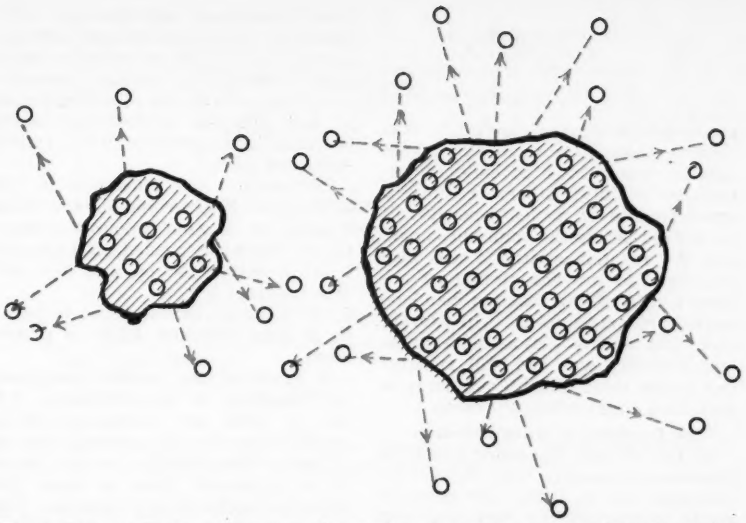


Fig. 2. In a small mass of uranium, the number of neutrons escaping from the surface is greater than the number produced by fission in the interior. In a large mass the reverse is true. The critical size of a device containing uranium is that for which the production of free neutrons by fission is just equal to their loss by escape and by non-fission capture

Unfortunately, however, since U235 is present in natural uranium only to the extent of about one part in 140 and because of the small difference in mass between the two isotopes, the problem of separation is an extremely difficult one. Nevertheless, the possibility of separating U235 was recognized early as being of greatest importance and such separation has, in fact, been one of the two major lines of the project effort during the past five years.

Another factor of great importance was the purification of the materials that might be used in a chain reaction. The degree to which neutrons are captured by different materials varies greatly. In some it is very high compared to that attained in uranium. It was evident, therefore, that if a chain reaction was to be realized, it would be necessary to reduce effect (3)—non-fission capture by impurities—to the point where it was not serious. This meant the very careful purification of the uranium metal and very careful purification of the moderator. Calculation indicated that the maximum permissible concentration of many impurity elements could be only a few parts per million in either the uranium or moderator. When it is recalled that up to 1940 the total amount of uranium metal produced in this country was not more than a few grams, and even this of doubtful purity, that the total amount of metallic beryllium produced was not more than a few pounds, that the total amount of concentrated deuterium (heavy hydrogen) produced was not more than a few pounds and that carbon had never been produced in quantity with anything like the purity required of a moderator, it will be clear that the problem of producing and purifying materials was a major one.

Control of the Chain Reaction

Assuming that materials could be produced that would make possible a chain reaction, a problem of great importance was that of control. The problem of control is different depending on whether we are interested in steady production of power or an explosion. In general, the steady production of power requires a slow-neutron-induced fission chain reaction occuring in a mixture or lattice of uranium and moderator, while an atomic bomb requires a fast neutron-induced fission reaction in U235 or Pu239, although both slow and fast-neutron fission may contribute in each case. It seemed likely, even in 1940, that by using neutron absorbers a power chain reaction could be controlled. It was also considered likely, though not certain, that such a chain reaction would be self limiting by virtue of the lower probability of fission-producing capture when a higher temperature was reached. Nevertheless, there was a possibility that a chain reacting system might get out of control and it therefore seemed necessary to perform the chain reaction experiment in an uninhabited location.

The fact that it appeared possible to produce a chain reaction did not insure that nuclear energy could be

made effective in a bomb. It was evident that in a bomb the chain reaction would have to build up extremely rapidly; otherwise only a small amount of nuclear energy will be utilized before the bomb flies apart and the reaction stops. It was also necessary to prevent premature explosion in case the reaction could be made rapid enough. As a matter of fact, this entire "detonation" problem probably was and still remains one of the most difficult problems in designing a high efficiency bomb.

The Possibility of Using Plutonium

So far, all this discussion has been concerned primarily with the use of uranium, that is, U235. We have already mentioned the fact that the element of atomic number 94 and mass 239, called plutonium, also is subject to fission, indeed in this respect it is the same as pure U235. We have also referred to the difficulties imposed by the problem of separating U235 from natural uranium. Uranium 235 and uranium 238 being isotopes are chemically identical. Plutonium, on the other hand is a different chemical element. Therefore, it was apparent that if a process could be worked out for converting some of the U238 into plutonium, a *chemical* separation of the plutonium from uranium might prove more practical than the *isotopic* separation of U235 from U238.

Suppose that we have set up a controllable chain reaction in a lattice of natural uranium and a moderator —say carbon in the form of graphite. Then as the chain reaction proceeds, neutrons are emitted in the process of fission of the U235 and many of these neutrons are absorbed by U238. This produces U239, each atom of which emits a beta particle, (an electron) becoming neptunium ($_{93}Np^{239}$). Neptunium, in turn emits another beta particle, becoming plutonium ($_{94}Pu^{239}$), which emits an alpha particle, decaying again to U235, but so slowly that in effect it is a stable element. If after the reaction has been allowed to proceed for a considerable time, the mixture of metals is removed, it was thought possible to extract the plutonium by chemical methods and purify it for use in a subsequent fission chain reaction of an explosive nature.

It is not possible, briefly, to describe all the different proposals and suggestions or the actual studies made in the development of the techniques that were finally followed but no possibility was overlooked. Three ways of increasing the likelihood of a chain reaction appeared possible: use of a moderator; attainment of high purity of materials; use of special material, either U235 or Pu. The three schemes were not mutually exclusive, and many schemes were proposed for using small amounts of separated U235 or Pu in a lattice composed primarily of ordinary uranium or uranium oxide and of a moderator or two different moderators. Such proposed arrangements were called "enriched piles."

Obviously it was impossible in the summer of 1940 to make more than a guess as to what amounts of material would be needed to produce:

(1) a chain reaction with the use of a moderator;

(2) a chain reaction bomb in pure, or at least enriched, U235 or plutonium.

A figure of one to 100 kilograms (a kilogram is approximately 2.2 lb) of U235 was commonly given at that time for the critical size of a bomb. This would, of course, have to be separated from at least 140 times as much natural uranium. For a slow neutron chain reaction using a moderator and unseparated uranium it was almost certain that *tons* of metal and of moderator would be required.

Availability of Materials

Estimates of the composition of the earth's crust show uranium present in considerable quantities—about four

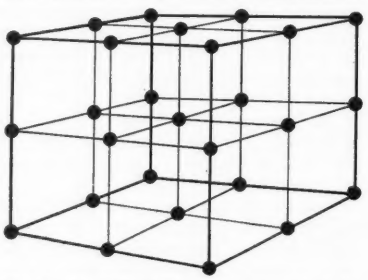


Fig. 3. A cubic lattice arrangement of the type suitable for use in a chain reaction pile

parts per million—but it is widely scattered and the difficulty of mining and of refining it are enormous. Early rough estimates, which are probably optimistic, were that the nuclear energy available in the known deposits of uranium was adequate to supply the total power needs of this country for 200 years (assuming utilization of U238 as well as U235). As already mentioned, however, little or no uranium metal had been produced up to 1940 and information was so scant that even the melting point of the metal was not known.

Power vs. the Atomic Bomb

Curiously enough, most of the early thinking about atomic energy by American scientists were with regard to its use for power. Even after the experimental confirmation of the process of fission in January, 1939, American-born nuclear physicists were so unaccustomed to the idea of using their science for military purposes that they hardly realized what needed to be done. Consequently the early efforts both at restricting publication of information and getting government support were stimulated by a small group of foreign-born physicists centering on L. Szilard and including E. Wigner, E. Teller, V. F. Weisskopf, and E. Fermi.

The expected military advantages of uranium bombs were far more spectacular than those of a uranium power plant. It was conceivable that a few uranium bombs might be decisive in winning the war for the side first putting them into use. Such thoughts were very much in the minds of those working in this field, but the attainment of a slow neutron chain reaction seemed a necessary preliminary step in the development of our knowledge and became the first objective of the group interested in this problem. This also seemed an important step in convincing military authorities and the more skeptical scientists that the whole notion was not a pipe dream. Partly for these reasons and partly because of the extreme secrecy imposed about this time, the idea of an atomic bomb does not appear much in the records between the summer of 1940 and the fall of 1941.

By the summer of 1940 the questions of most importance were:

(1) Could any circumstances be found under which the chain reaction would go?

(2) Could the isotope U235 be separated on a large scale?

(3) Could moderator and other materials (such as Pu239) be obtained in sufficient purity and quantity?

Although there were many subsidiary problems, these three questions determined the course of the subsequent work.

In June, 1940, nearly all work on the chain reaction was concentrated at Columbia University under the general leadership of Pegram, with Fermi and Szilard in immediate charge. It had been concluded that the most-easily produced chain reaction was probably that depending upon thermal[1] neutron fission in a heterogeneous mixture of graphite and uranium.

The slowing down of neutrons in graphite was investigated by studying the activation of various detectors (rhodium, indium, iodine) placed at various positions inside a rectangular graphite column about 3 by 3 ft square and 8 ft high when a source of neutrons was placed inside. The presence of neutrons can be detected by ionization chambers or counters or by the artificial radioactivity induced in various metal foils. The response of each of these detectors depends upon particular characteristics of the detector and on the speed of the neutrons. (e.g. neutrons of about 1.5 volts energy are particularly effective in activating indium.) Furthermore, certain materials have

[1] Thermal neutrons is the name given to neutrons having so-called thermal velocities.

very large absorption characteristics for neutrons of particular ranges of speed. (e.g. cadmium for thermal neutrons).

The experiments on slowing down neutrons showed that high energy, that is, high speed neutrons, such as those from fission, were practically all reduced to thermal energies, that is low speeds, after passing through 40 centimeters or more of graphite. A piece of uranium placed in a region where thermal neutrons are present absorbs the thermal neutrons and, as fission occurs, re-emits fast neutrons which are easily distinguished from the thermal neutrons. Extensive calculations were made on the probable number of neutrons escaping from lattices of various designs and sizes. This was fundamental for the so-called intermediate experiment which was necessary before a program could be planned for building an actual chain reaction pile.

About July, 1941, the first lattice structure of graphite and uranium was set up at Columbia University. It was a graphite cube about 8 ft on an edge and contained about 7 tons of uranium oxide in iron containers distributed at equal intervals throughout the graphite. As already pointed out, a source of neutrons can be obtained by bombarding a small piece of beryllium with radium rays. Thus a radium-beryllium neutron source was placed near the bottom of the lattice structure and then it was possible to measure the number of neutrons at various points throughout the lattice. These numbers were then compared with the corresponding numbers determined when no uranium was present in the graphite mass.

The real purpose of this experiment was to determine whether a reaction pile could be designed in which the number of neutrons produced by fission would be greater than the number of neutrons which escaped from the surface. It was evident that if the number of neutrons escaping from the surface was greater than the number of neutrons produced by the chain reaction in the interior, then the chain reaction could not sustain itself. On the other hand, if the chain reaction produced more neutrons than escaped from the surface, then the chain reaction would sustain itself and the experiment would be a success. The first results of the measurements were not very encouraging —the number of neutrons produced was small—but it was felt that the number of neutrons produced could be increased and so the experiments were continued.

While this work on the chain reaction pile was going on, other investigations were carried on on the separation of U235 from U238. As already described, a minute amount of uranium 235 had been separated by Professor A. O. Nier by means of the mass spectrograph. Since the mass spectrograph works on the principle of electromagnetic separation this resulted in further experiments with larger types of electromagnetic separation equipment. This work was carried on at Berkeley by E. O. Lawrence. Lawrence was remarkably successful and by December 6, 1941, reported that he could deposit, in one hour, one microgram of U235 from which a large proportion of the U238 had been removed.

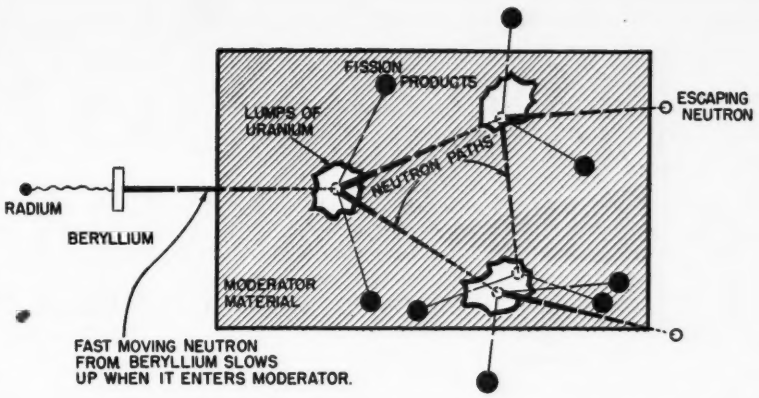


Fig. 4. Diagram showing the principle of a chain reaction in a device using lumps of uranium embedded in a neutron moderator material

As a matter of fact, four different ways to separate U235 from U238 were possible and had been investigated. These four methods are illustrated in an accompanying illustration. The first shows the electromagnetic method just referred to. It makes use of the principle that the lighter U235 particles are deflected more than the heavy U238 particles in a strong magnetic field. By arranging properly designed collector chambers at correct points, the U235 can be collected in one chamber and the U238 in another.

Another method of separation is the so-called thermal - diffusion method. In this, fluid uranium circulates in the annular space between an inside hot wire or cylinder and an outside cold cylinder. Under these conditions the lighter U235 tends to concentrate at the top and can be removed. This method had been previously investigated at the General Electric Company research laboratories.

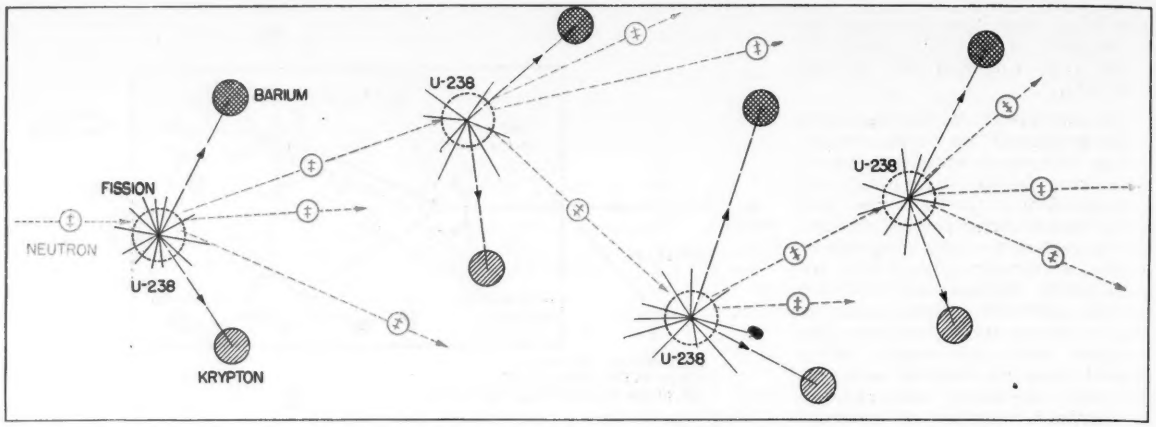
A third method of separating U235 from U238 was by the gaseous diffusion method where use is made of a porous barrier. The gaseous mixture of the two elements U235 and U238 is placed on one side of the barrier under high pressure. With such an arrangement it is found that the lighter U235 gas passes more readily through the barrier than the heavy U238 and consequently a separation process is possible.

The fourth method of separation makes use of a centrifuge. When a mixture of gasified U235 and U238 is spun around rapidly the lighter U235 tends to collect towards the center.

By the end of 1941 all of these four methods had been experimentally demonstrated in principle. Both the centrifuge and the gaseous diffusion methods seemed to offer promising results and it was thought possible that relatively large quantities of U235 could be separated from U238 by either of these two methods.

As a matter of fact, by the end of 1941 an extensive review of the whole uranium situation had been completed. True, the tangible progress had not been great. No chain reaction had been achieved, no appreciable amount of U235 had been separated from U238, only a minute amount of Pu 239 had been produced, the production of large quantities of uranium metal, heavy water, beryllium and pure graphite were still largely in the discussion stage. However, there had been progress. Constants were better known; calculations had been checked and extended, guesses as to the existence and nuclear properties of Pu239 had been verified. Some study had been made of engineering problems, process effectiveness, cost and time schedules. Most important of all, the critical size of the bomb had been shown to be almost certainly within practical limits. Altogether the likelihood that the problems might be solved seemed greater in every case then it had in 1940. Perhaps more important than the actual change was the psychological change. Perhaps the originators of the idea were no more thoroughly convinced that atomic bombs were possible than they had been in 1940, but many other people had become familiar with the idea and its possible consequences.

Apparently the British and the Germans, both grimly at war, thought the problem worth undertaking. Fur-



By 1941 the possibility of a slow nuclear chain reaction such as shown here had been investigated and prospects of success appeared encouraging.
Also, it appeared possible:

1. **To produce Plutonium (Pu-239) from Uranium 238 by such a chain reaction.**
2. **To separate U-235 from U-238 by any or all of the four processes shown below.**

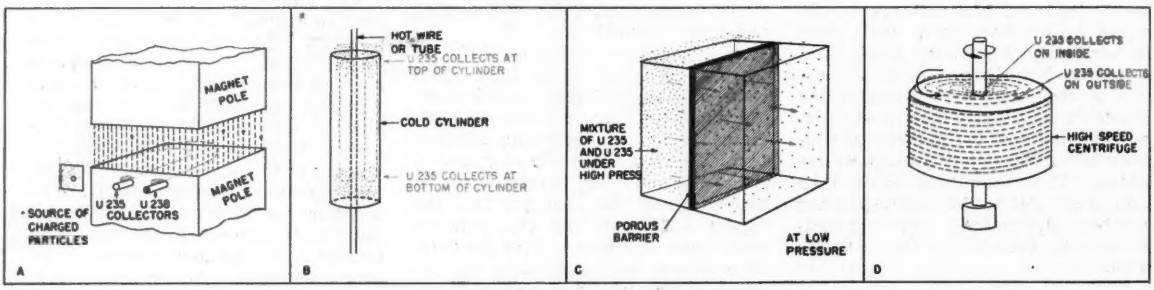


Fig. 5. General state of development in 1941.

thermore, the whole national psychology had changed. Although the attack at Pearl Harbor was yet to come the impending threat of war was much more keenly felt than before and expenditures of effort and money that would have seemed enormous in 1940 were considered obviously necessary precautions in December, 1941. Thus it was not surprising that Dr. Vannevar Bush and his associates felt it was time to push the uranium project vigorously. For this purpose there was created an entirely new administrative organization.

This decision was approved by President Roosevelt. From January, 1942, until early summer of 1942 the uranium work was directed by Bush and Conant working with the program chiefs and a planning board. In the summer of 1942, the Army through the Corps of Engineers, was assigned an active part in the procurement and engineering phases, organizing the Manhattan District for the purpose. In September, 1942, Dr. Bush, Dr. Conant, General Styer and Admiral Purnell were appointed as a military policy committee to determine the general policies of the whole project. Also, in September, General Groves was appointed to take charge of all Army activities of the project. The period of joint Office of Scientific Research and Development and Army control continued through April, 1943, with the Army paying an increasingly important role as the industrial effort got fully under way.

Thus, to recapitulate, it will be seen that there were two phases to the project. First, there was the program involved in promoting a slow chain reaction; first to see whether such a chain reaction could be self-sustaining and second to use such a chain reaction in the production of plutonium, Pu239, from Uranium 238. The other major part of the program involved separation of U235 from U238 by any of the four different methods described.

As will be described in subsequent articles, practically all of the research on the promotion of a chain reaction was carried out at the University of Chicago under an organization which was cryptically named "Metallurgical Laboratory." The work done at Chicago was subsequently incorporated in the building of the Hanford Engineering Works at Pasco, Washington, where the production of plutonium was carried on on a large scale.

The four separation processes were subsequently all carried on at the Clinton Engineer Works near Oak Ridge, Tennessee. As was already pointed out in the previous article, the first self-sustaining chain reaction pile went into operation in Chicago in December, 1942. How this pile was designed and details of its operation will be discussed in an article in the next issue.

ATOMICS

The PRACTICAL ENGINEER and ELECTRICIAN

ANDREW W. KRAMER, EDITOR

Printing Strike Settled

A strike by a printing trade union in Chicago has delayed publication of the October issue of POWER PLANT ENGINEERING. The printing situation has been difficult in all parts of the country for many months due to a serious shortage of skilled printing personnel which has interfered with our customary regularity of publication.

As publishers, we are only customers of the printers and had no direct voice in settling the strike but we were vitally concerned in furnishing our good friends and subscribers with issues of POWER PLANT ENGINEERING on our regular monthly publication dates.

It is not our intention to discuss here the merits of demerits of the controversy. We do want you to know, however, that the Technical Publishing Company has been working night and day to bring the contending parties into agreement and finally a satisfactory settlement was reached.

All material for the October issue of POWER PLANT ENGINEERING had been in the hands of our printing company for several weeks and the minute the strike was over we were able to start printing.

Your October issue is late but we know you will find it up to the regular standards of quality. The November issue will follow as soon as possible.

Your patience and understanding through this difficult time is sincerely appreciated.

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A Section of Power Plant Engineering Devoted to PLANT OPERATION AND MAINTENANCE

Technical Publishing Company
53 West Jackson Blvd., Chicago 4, Ill.

Training of Practical Engineers

One of the problems facing industry in the post-war period will be the training of power plant operators. In the past operators as a rule came up the hard way, learning by experience. Many returning war veterans will never have held civilian jobs. If these men are to be taken into the power plant, how will these men be trained and what will they be taught? Who is going to train them? These are some of the factors which need attention, not only on the part of management but the operators as well. Suggestions and discussion by other engineers and operators on Mr. Mosher's article will be welcomed

By FRED D. MOSHER

PROBABLY no nation is more "vocational training" minded than the United States. One of the major criticisms pointed at our educational system is that we put *too much* emphasis on education that will equip our people with knowledge of the useful kind. The word "useful" being used here to connote training in the manual arts, or, if you choose, industrial arts.

In spite of the millions of dollars spent annually in schools of the industrial arts type we never seem to train adequately those of us who have to work with practical things. It is thought that the reason for this is that it is the nature of our people to advance any science so rapidly that it is just impossible for the educators to keep pace. Training is not something that can be taken in a gulp, or put on a mass-production basis. But it does appear at times that our industrial advances, tangible and intangible, are made in great strides and that training for the new tasks provided lags woefully behind. Let some industrial development start to accelerate and thousands of "schools" with capsule education come following in the wake.

However, this is not intended to be a dissertation on education nor does it intend to probe the upper reaches of pedagoguery. What *is* intended for discussion is educational background and training for practical engineers. By practical engineers is meant the term applied to the men who are the backbone of any power plant, and on whose shoulders rest the responsibilities for keeping the wheels turning. In the future we will need more of them, and we will want them well-trained.

When the war ends there will be a pent-up flood of new developments released to industry. In the field of power plants high pressure equipment, which had a good start just before the war, will be the standard in power plants. The Government will certainly encourage the use of low grade coals and new techniques in burning will have to be learned. The active research now being carried out in the development of a commercial combustion turbine will sooner or later produce such a prime mover for stationary power plants.

New concepts of power plant operation will be introduced to eliminate waste, to produce power more cheaply, and to attain higher overall efficiencies in the production of steam and power.

It is almost trite to say that a plant is no more efficient than the personnel who operate it. To go further and say that present methods of operation *are* efficient would simply be flying in the face of what we know to be the contrary.

Experience Based on Mere Repetition, Worthless

In the past the emphasis has seemed to be placed on experience where power plant operators are concerned. Many owners of plants seem to have overlooked the fact that experience, if it is based on repetition of bad habits, is almost worthless and at best a molder of inefficiency. There is very little that can be done to prevent a given individual from forming bad habits, but there is a great need for ways and means of inculcating good habits.

How much should a practical engineer know? This question is most difficult to answer, and an easier solution to this one would seem to be in trying to find out what he should be taught.

In the past some very fine practical engineers had little more than a Grammar School education. But they were men who had learned the "hard way." At war's end there just won't be enough of the "old-timers" to go around; there will not be the time available to drill engineers in everyday operating practices—that is the time we now consider necessary.

Many of our returning war veterans have never held a civilian job of any kind. Due to the thousands of problems peculiar to the conduct of a Word War it just is not logical that every potential operating engineer will return Army-or Navy-trained for a peacetime job in power plant operating. Some of the fortunate will have such training, but thousands of others just won't.

Industry, then will be faced with a new problem: To draw from the thousands those who are best fitted for engineering in a practical way. The best that we can expect is that those who are interested in the vocation will have some formal educational background and a desire to learn.

It should also be assumed that Government educational programs, although well-conceived, and carried out with the highest motives, will lack, because of the size of the programs, the selectiveness that would seem to be necessary. Also, many young men will not take advantage of the opportunities offered by the Government. Others, even though they draw pay while they learn, will try and get into civilian employment as soon as possible. Unless the Government considers the regional problems involved any system that can possibly be set up will have a certain rigidity about it that will detract some of its value. For example: Will the Government, in offering courses in combustion consider all the ways in which various fuels are now being burned, or will it attempt to teach the subject on a regional basis? If the whole field of combustion is to be covered considerable time may elapse before a man is considered qualified. If a regional system is set up where will oil-burning be taught and where will the emphasis be placed on pulverized coal? What about the plant that uses multiple fuels with a Diesel or two thrown in? Obviously a limit will have to be placed somewhere, and when a limit is placed somebody will be left out.

Cooperation of Industry with Vocational Schools

It would appear that industry itself might do something about it. But it cannot be expected that every power plant in the country must set up a school or training course of its own. But, there does seem to be possibilities of industries and individual plants working with local Vocational Schools to properly train manpower.

Considerable experience has been had, particularly in the schools of Professional grade, with the cooperative system. Industry, in a limited way, has tried out the cooperative system particularly in engineering, but for the most part this activity has been confined to engineers seeking degrees in the various branches of engineering.

An extension of the cooperative system, or a broadening of the practice, would offer to practical engineers opportunities of a nature that would make this kind of engineering attractive and very much worthwhile. Any such system should not be confined to teaching adolescents of young men of High School age; many adults; in-

dustrially dislocated during the war, should also have a chance to learn the fundamentals of practical engineering and participate in such training activities as may become available.

High School education or its equivalent would seem to be a pre-requisite for practical engineering training. The day is no doubt past when "hard knocks" alone will provide adequate educational background. One of the drawbacks of many practical engineers is that, in many instances, he very quickly reaches the point where his value to the organization levels off. He must rely too much on the "front office" for the handling of minor details in connection with the operation of his department. In many unfortunate cases morale of the operating organization has been impaired when "new blood" was used as an excuse to bring young college graduates in to fill the old-timer's shoes. The young graduate engineer is often quite out of place as an operator simply because of his training. Often a good coalition of book learning and experience will work wonders, but a better arrangement seems to be the putting of a good practical engineer at the head of the organization and furnishing him with capable technical assistants.

The practical engineer of the future, graduated from High School or a recognized school of the Vocational type, will be trained in a post-High School institution where opportunities to study industrial plants and organizations are provided. The institution should get the active support of industries in the locality. The peculiar needs of the community industries should be considered in the formulation of the curricula. The trends in power plant developments should be recognized and the instruction offered should be geared to go along with these developments. It would be of vital interest to industry to foster the growth of such institutions.

The kind of institution we have in mind would provide education on the cooperative plan. This kind of plan would allow trainees to participate in the actual operation of equipment, and the actual "know how" would be acquired as the student progressed. Classes should be open to adults who wish to go back and make up deficiencies in formal education. It should not be taken from this that a suggestion is being made that private enterprise undertake the education of the masses, but it *is* suggested that properly trained men will be required in the future, and that industry stands to benefit from any such program.

What Should An Operator Be Taught?

What should the curriculum for training practical power plant engineers include? The elements of heat engineering would appear to be a "must" on the list of subjects to be taught. It is not necessary to teach advanced Thermodynamics to a man who expects to make his living operating power plants. It is essential, though, that he understand the simple processes involved in the conversion of energy. The practical engineer is required to deal with "applications" rather than theories, and for this reason he should get a maximum drill in the *use* of the tools of engineering rather than in the study of the origins of these tools—the "tools" as used here meaning the sciences of mathematics, physics, etc.

To those who are concerned about the training of practical men in the future there are several outstanding examples of the cooperative type of educational program in operation from which much can be learned.

A number of large corporations have operated apprentice schools for many years with varying degrees of success. In some of them, such as the General Electric Company, scientific selection is based on the results of series of tests. In colleges where the cooperative plan is in operation certain entrance requirements are set up stipulating the pre-requisite education required. In all of the programs the "practical" aspects of the training are outstanding features.

A noteworthy cooperative program in cooperative education has been carried on in Rochester, New York, for a number of years. The Rochester Athenaeum and Mechanics Institute is an outstanding example of a "training-for-industry" school. The school at Rochester is privately endowed; it is non-profit-making; it is a technical institution offering courses to follow High School graduation. The school emphasizes standard pay for working students. The students are actively employed, on the cooperative basis, in jobs for which they are being trained in the classrooms; as a student progresses in his studies and in the plant he is given added responsibilities so that when he finishes his course he is ready to take on responsibilities.

The promotion-from-within philosophy of industry which has been further developed during the war years will be given a better chance of successful operation if personnel are properly trained. The scientific advances now being made will require

"When I told you to get acquainted with your new work here, Carnish, I'm afraid you took me too literally!"

highly trained practical men if industry is to profit from them.

Industry as well as those who operate it has an opportunity to correct a defect in our educational system. The idea of extending cooperative educational programs is worthy of a trial, and management can play an important part. With demobilization there will be released millions of young men in need of guidance and training for useful enterprise. If the nation, and consequently its industries which make up its backbone, is to advance to higher peaks and give to all a better and more adequate standard of living, the education of practical engineers must get the attention of industrial leaders and the place in our educational system that it deserves.

FOR THE PLANT ELECTRICIAN

Grinding Collector Rings Helps Regulator Performance

By A. V. Kilpatrick

MY ORIGINAL intention in writing this article was to show how quickly the sliprings, or collector rings could be ground round and true on a large a-c generator with a standard Dumore portable grinder.

Figure 1, shows the grinder in operation on an improvised machine slide grinding the 24 in. dia cast iron collector rings with the Nordberg uniflow steam engine, direct connected to the General Electric a-c generator, running at full speed of 200 rpm on its own power.

This generator had run so long that the rings had worn enough to require about 1/10 in. to be removed from the diameter to bring them round and smooth. This was done in about 3 hours of set up and grinding time using a 2 in. by ⅜ in. Niagara Falls Carborundum grinding wheel.

Now comes the interesting part. Much trouble had been encountered for some years with the General Electric Tirrill type voltage regulator. The relay contact points would burn and sometimes weld together so as to burn out the resistance coils on the switch board. This required weekly repairs and adjustment by an expert electrician. Even tungsten points would last only a few days. Since dressing the collector rings on the main generator several months ago no trouble has developed in the voltage regulator to date. My explanation of what happened is as follows: While an alternator is supposed to make a sine wave for voltage and current, a bus bar oscillogram will look something like Fig. 2, showing that while the voltage curves are fairly smooth the current waves are greatly distorted. This may be caused by influences outside of the generator itself like inductance, condensance, and resistance, and reactance of leading or lagging currents of induction motors on the line or from anything that might distort the voltage sine wave coming from within the generator itself due to unsteady exciting d-c voltage and current. My guess is that the trouble with the voltage regulator came from the high frequency, high current peaks like a,a and b,b, in Fig. 2, synchronized

Fig. 1. Grinder in operation on an improvised machine slide

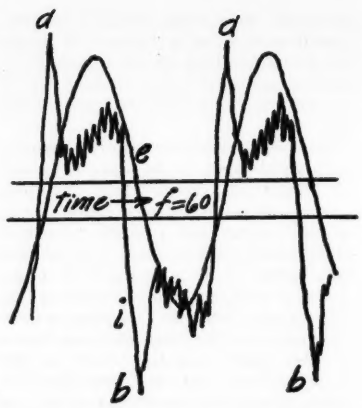


Fig. 2. Probable wave shape resulting from poor collector ring action

with some of the closings of the relay points on the Tirrill regulator causing them to weld together since welding heat is produced by a high current. The familiar I^2r loss together with the instantaneous high frequency change of all distortion points on the current wave, i.

It would be of interest to have opinions of others who have had like experiences. The moral of all this is: Keep the collector rings in good shape and the commutation correct on the exciter generator or in other words keep the exciting current smooth and there will be less trouble with bus bar regulation, and probably less trouble with all motors and apparatus on the power lines.

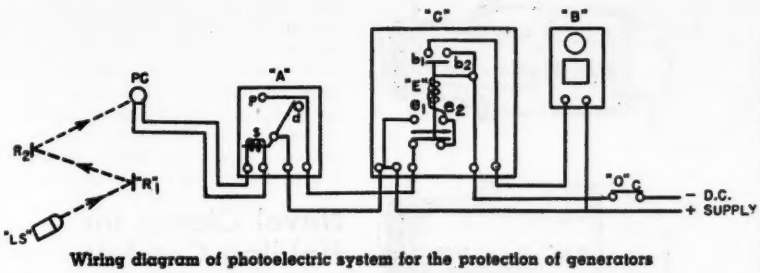
Photoelectric Protection for Electric Generators

By C. O. von Dannenberg

THE PROTECTION of generating and similar equipment against damage due to internal electrical failures is a most necessary feature. Most units of any appreciable capacity have cooling systems with ducts in which it is possible to install devices capable of giving indications, often in advance of conventional relay protective systems, during early stages, through the presence of smoke or vapor. The details given apply to equipment well known and readily obtainable, although application for the purpose described does not seem in general use.

The basic element in the application is that of a photoelectric element which has sufficient response to a light ray of proper intensity to operate a microammeter which switches on an initiating relay which in turn controls an alarm bell or indicating signal.

Referring to the accompanying diagram, light source "LS" consisting of a lighting unit with condensing lens impinges a light ray upon the photoelectric element "PC" by the way of



Wiring diagram of photoelectric system for the protection of generators

the reflectors R_1 and R_4; the light effect upon PC generates sufficient potential to cause microammeter relay "A" to operate, the pointer moving away from contact "P." This condition is shown in the diagram and is the one existing during normal operation of the unit to which it is applied.

Should the light ray between "LS" and "PC" be interfered with the effect on "PC" will reduce the current and the pointer of relay "A" will move to the left to make contact with "P" energizing coil "E" of contactor "C" causing the armature to rise and close contacts b_1 and b_2 to start the alarm "B" at the same time the armature of "C" rises the relay is "sealed" in the closed position by the closing of e_1 and e_2 and alarm "B" continues to operate until switch "O" is opened. The d-c supply is taken where possible from a station battery or an equally reliable source.

The system as previously stated operates when there is any interference with or reduction in the intensity of the light ray between "LS" and "PC" or if an open circuit occurred between "PC and "A." Such an effect would include a failure of the light source unit, depreciation of the photoelectric cell or dirt on the reflectors; these causes would cause a fault indication which can be classed as a supervisory function similar to that of a railway signal indicating danger through a fault in the electrical or control system.

Passing the light ray across the air duct a number of times amplifies the effect of any vapor upon the diminution of its intensity and of course makes the current change in coil "S" of relay "A" more pronounced. Some adjustment and trial may of course be required to suit each application.

This description does not imply the omission of the usual type of differential relay protection but rather to supplement it as an adjunct which may aid in giving an earlier indication of some unusual condition.[1]

[1] Editor's note: While it is true that the differential relay method of protection is sensitive to "break-down" to a high degree, there must be some sort of actual break-down or an electrical disturbance of some kind must be initiated before such systems come into action and this means some damage. While the system proposed here is intended only as an addition to existing protective systems, it should be well worth having since it indicates, as the fire protection authorities say, a condition of incipient danger.

New Starting Device Developed for Aero Engines

AN INTERESTING device for starting aircraft engines has been developed by the Beez Corporation, Inc., of Newark, N. J. While this device has been developed primarily for starting aircraft engines, there is no reason why it cannot be developed for use in other applications where space is at a premium. The starting of aircraft engines has long been a source of trouble especially with modern high-powered military and naval engines where it is necessary to travel from warm to sub-zero temperature regions in a short space of time. This new starter known as the Cartridge Engine Starter has been a boon to airforce pilots and ground crews and to commercial airlines.

The theory behind this new and easy starting device is to use the latent energy of a fuel contained in a cartridge, placed in a specially designed beach mounted in the cockpit or under the cowling to provide torque to turn the engine over at a speed sufficient for starting.

Its advantages are: 1, Ample power yet minimum torsional shock to the engine parts; 2, the pilot can start it quickly without the aid of ground mechanics; 3, no drain on storage batteries thus enabling light weight batteries to be used which increases pay load; 4, since far less timing is required to start, engine life is increased.

In operation the cartridge is placed in the breech, then when electrical contact is made it ignites a quick burning powder which in turn drives slow burning pellets into a combustion chamber. Then as combustion proceeds it builds up gas pressure in the piston. The power stroke begins when the helical splines impart an accelerating rotary movement to the clutch jaws. The engine has made three revolutions when the power stroke is completed and then a valve in the head opens and a helical spring returns the piston to the starting position. A 30 ton thrust is converted into 180 rpm of the crankshaft.

It is readily apparent that this mechanism subjects to high stress and

The Old and the New

Half a century of craftsmanship is represented by this veteran motor-builder and the two products of his skill. Affectionately he examines the one-half horsepower motor at the left which, as an armature winder's helper, he helped construct in 1894 for an Allis-Chalmers predecessor company. Over 50 years later he applied his skill as an Allis-Chalmers slotter to help produce the modern one horsepower motor at the right.

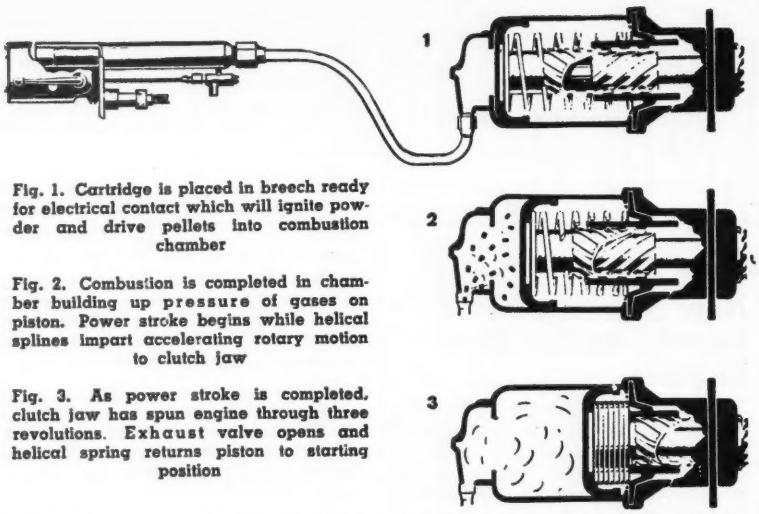


Fig. 1. Cartridge is placed in breech ready for electrical contact which will ignite powder and drive pellets into combustion chamber

Fig. 2. Combustion is completed in chamber building up pressure of gases on piston. Power stroke begins while helical splines impart accelerating rotary motion to clutch jaw

Fig. 3. As power stroke is completed, clutch jaw has spun engine through three revolutions. Exhaust valve opens and helical spring returns piston to starting position

shock its main working parts which requires the use of strong and tough alloy steel. Since corrosion resistance is also a consideration, stainless steel is specified for the cylinder forging and for parts of the breech mechanism which are forged and heat treated.

PRACTICAL HINTS AND KINKS

Special Filing Machine

IN THE manufacture of small instrument-type motors, slots in the stator cores are filed to remove burrs and irregularities on the sides in order to facilitate winding. The file must be safe on the bottom edge to prevent scoring of the bottom of the slots, which would be detrimental to the magnetic properties of the core. Joseph Geenens, an assistant general foreman at a General Electric plant, has developed a special filing machine to do this work which, by eliminating hand filing methods, has resulted in considerable saving in time and money.

A tail stock assembly from a winding machine, a small motor with speed reducer, a holding fixture, and a file make up the unit. The motor drives the advancing crank wheel of the center shaft of the tail stock in reciprocal motion. The file is attached to the center shaft and guided by a slot in holding fixture. The core is held by spring pressure in the holding fixture and the file may be held in the core slot either by hand or spring pressure. A stop is provided on the fixture indicating that the slot filing is complete and to aid in preventing interference with the bottom of the slot. A warding file of proper size is used to give the correct slot width.

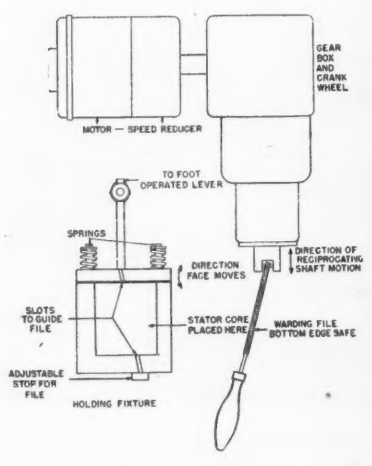


Fig. 1. Details of filing machine designed to file small motor slots

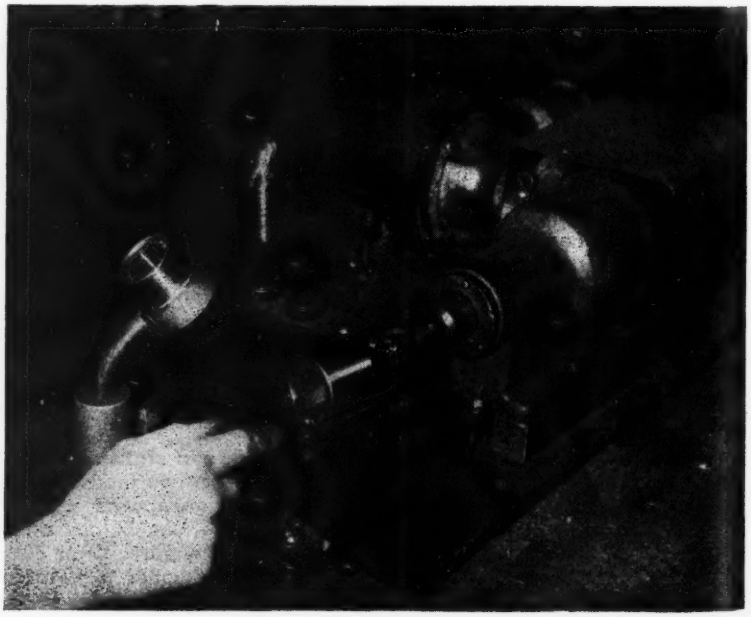


Fig. 2. Photograph of the machine in use

Novel Clamp for Holding Conduit

DEVELOPMENT of a new type clamp, particularly adaptable for tube and conduit type installations of all kinds, has been announced by The Glenn L. Martin Co., Baltimore, Md. The development is another step forward in Martin's program to further ease of maintenance and simplicity of design in the planes which the company builds, but this clamp should have many other applications aside from its use on airplanes.

The clamp is shaped after an inverted lateral "s" and is fastened to the wall or frame with an ordinary screw. The tubing to be fastened is placed in the open side of the curve and the clamping ring passes around the back of the base, over the top of the tubing and down the front where it is hooked under the curve at the front of the "s" to form a simple locking device.

The clamping ring can be made of a high grade synthetic rubber or other elastic material. At the present time, the Martin plants are using standard hydraulic seal "o" rings which have been rejected for use as hydraulic seals because of improper tolerances. The rubber ring also serves as a "shock absorber" in eliminating vibration. If it is damaged and necessitates replacement, this can be accomplished without removing the clamp body.

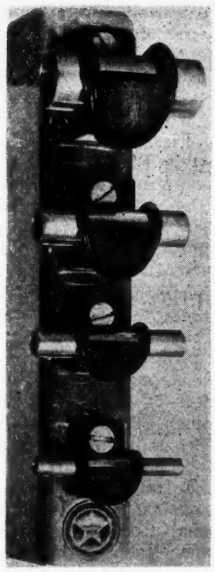


Fig. 1. Clamp for holding conduit or pipe developed at the Glenn Martin Co.

The clamp proper can be moulded from a fabric base phenol fiber material or fabricated from formed sheet metal in any desired size. The combination results in a clamp which is extremely durable, yet light in weight and attractive.

Now being used in plane installations for fastening hydraulic and pneumatic tubing, wire bundles and electrical conduits, the bodies are moulded in color to follow individual hydraulic or electrical runs.

The clamp is an answer to the "mechanics prayer" for in addition to needing no tools for installation or removal of objects, the clamps afford other conveniences. There are no loose parts to be lost or broken, and when the clamps are used in a series, any single tube or conduit can be removed without disturbing the others. The clamp also is readily adaptable for bonding.

Use of the clamp is in no way restricted to only plane production and could be readily used for other purposes such as fastening plumbing in housing. This can be done by merely substituting a fiber-glass clamping ring to obtain the necessary durability for long periods of time.

Though the Martin Company has not started production in large quantities on the clamps at the present time, this work will get underway soon either through their own facilities or those of a licensee organization.

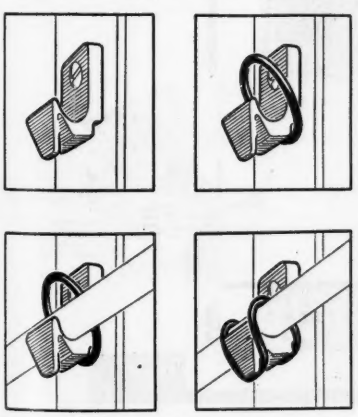
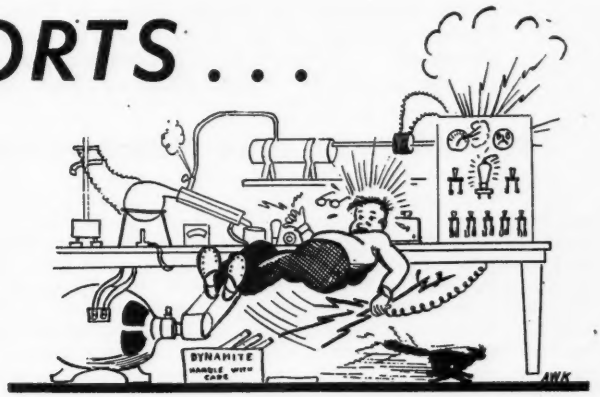


Fig. 2. Diagrams showing application of clamp

SHORTS . . .



WHILE visiting a power plant not long ago, the chief engineer of the plant called our attention to a rather interesting problem he had. "Those pigeons you see perched on the piping of these cold boilers," he said, "are quite a nuisance. They come through the open windows, have built a nest under the deaerating heater and have messed things up in general. Once a couple of them got into the engine room through the steam header opening. When we find too many pigeons camping in our boiler room one of the boys brings down his shotgun and we have a pigeon pie day. Shooting around boiler and piping, however, isn't good procedure. Got any good ideas for pigeon traps?" This it seems is a job for a pigeoneer.

* * *

FIFTY-THREE new synthetic rubbers were produced in the three synthetic rubber plants operated by the United States Rubber Co. during 1944 according to J. P. Coe, General Manager of the Company's Naugatuck Chemical and Synthetic Rubber Divisions. Of these new rubbers, 8 types have been adopted for regular use in the manufacture of rubber insulation of electric wire and cable, porous rubber, storage battery seperators, asbestos sheet packing, and pressure sensitive adhesives. Of the other 45 types many are being evaluated. This work is being carried out under the supervision of Rubber Reserve Co. as part of the Government's synthetic rubber program.

* * *

IN RESISTANCE welding the term "Projection welding" has come into more or less common use. Projection welding is that method of resistance welding in which the localization of pressure and current is accomplished by means of irregularities formed in one or both of the weldments being assembled. These irregularities allow the use of flat, plain or die type electrodes on the welding machine itself. Current densities on the dies are likewise decreased allowing the use of lower conductivity, harder electrode materials which results in considerable reduction in electrode or die maintenance on this type of equipment.

The method of projection welding allows the close placing of several welds because of the fact that all welds are made simultaneously so that there is no shunting effect from previously formed welds which would tend to absorb a portion of the secondary current produced by the machine for the formation of a weld.

* * *

FEW SUBSTANCES contain as much heat energy as crude oil. A pound of crude oil contains about 19,000 Btus of energy. This compares with coal which has an average value of 15,000 Btus per pound. Grain alcohol on the other hand, has only 11,760 Btus per pound while nitroglycerine has a low value of 3400 Btus per pound. Wood is ordinarily rated to have 7500 Btus per pound.

* * *

IN 2600 BC the Chinese Emperor Hoang-ti used a magnet (as a compass needle) to guide his chariot. Today magnets have countless applications. They have gone to war in airplanes, tanks, in motors of all kinds, and in secret fighting equipment but the natural properties of the magnet are still mystifying. The spinning electron is accepted as the ultimate source of magnetism but no one has ever been actually able to answer the question, "What Is Magnetism?" At the General Electric Company one magnet made of Alnico and placed in a special assembly has been recorded as lifting 4450 times its own weight. Engineers have called this the most powerful magnet in the world.

The Boiler Fireman's Handbook

By J. R. DARNELL

Rotary Spreaders—Horizontal Grates of Either Stationary, Dumping or Traveling Type . . . Method of Operation . . . Overfire Air . . . Cleaning grates . . . Fly ash problems . . . Coal sizing . . . Heat release

Part XV—Stoker Firing Methods—(Continued)

ROTARY SPREADER types of stokers have been known and in more or less limited use for at least 50 years. In the past 10 years, however, they have been in much greater demand since they have been developed to such extent that they are as efficient as other types of stokers and, in many cases, more flexible.

Spreader type stokers are adapted to burning coals with characteristics more widely varying than any other type of stoker. The advantages of stoker and pulverized coal firing are combined in one machine. Larger particles are burned on a grate while the fines are burned in suspension.

High ash, high volatile coals, subbituminous coals and lignites, generally burned on chain grate stokers above can be burned on the spreader stoker without clinker formation. Eastern coals with caking characteristics, usually burned on underfeed stokers, also can be burned successfully on the spreader stoker. Difficulties due to clinkering or caking are avoided because of the flat grate and thin level fuel bed and because a considerable portion of the fuel is burned in suspension.

Rotary spreader stokers may have either under or overthrow action. Figures 1 and 2 both show how the coal is fed to the rotor in underthrow types. These rotors or spreaders have blades arranged in four rows, 90 degrees apart and parallel to the axis of the shaft. The arrangement of the blades is such that alternate rows throw the fuel to the right and left respectively. The resultant cross firing provides uniform distribution of coal on the grate. Figure 1 also shows the zone of water cooling for the bearings of the spreader shaft.

Figures 3 and 4 illustrate coal spreading with an overthrow type of rotor. In Fig. 3 the grates are stationary while Fig. 4 shows a power dumping type of grate which may be operated by either steam or compressed air cylinders. The dumping type of grate also can be furnished with levers for hand operation.

In the earlier stages of the development of the spreader stoker, installations were confined to boiler of less than 500 blrhp but improved designs gradually stepped up the capacity until boilers of 1000 blrhp and over were common. Today there are a few installations under boilers having approximately 20,000 sq ft of heating surface. Installations designed to generate 100,000 lb of steam or more per hr usually consist of 4 or more grate zones, each with a separate spreader unit. Figure 5 shows a spreader stoker with power operated dumping grates installed under a sectional header boiler of 19.760 sq ft and generating 126,000 lb steam per hr.

To eliminate varying fuel bed conditions such as variation in the depth of the ash and changes in furnace conditions occurring during cleaning periods when using multi section grates and spreaders, particularly with coals of high ash content, one manufacturer has developed a special type of slow-speed traveling grate stoker used in conjunction with rotary spreaders, the stoker traveling in a direction reverse from the conventional types, that is, the coal on the grate is moved forward toward the spreader and the ash is discharged at the front end of the stoker. Figure

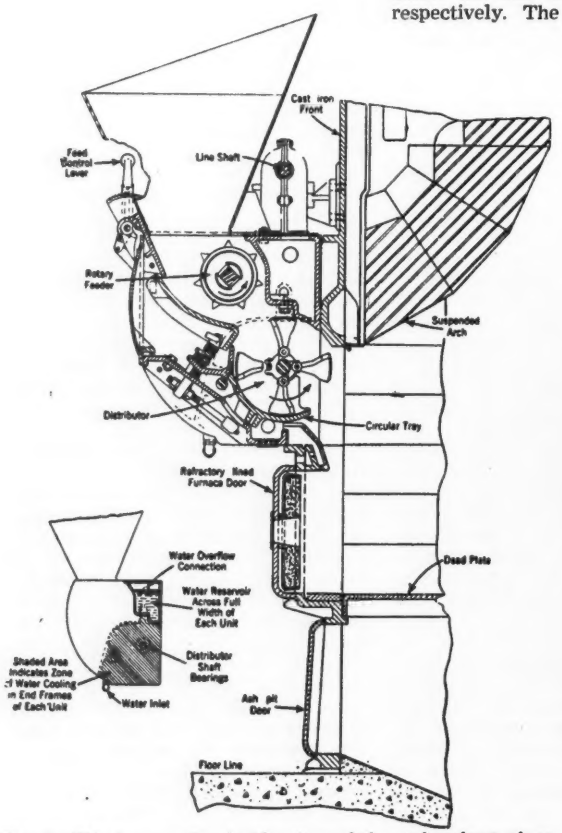


Fig. 1. This is a sectional side view of the stoker front of an underthrow type of coal spreader

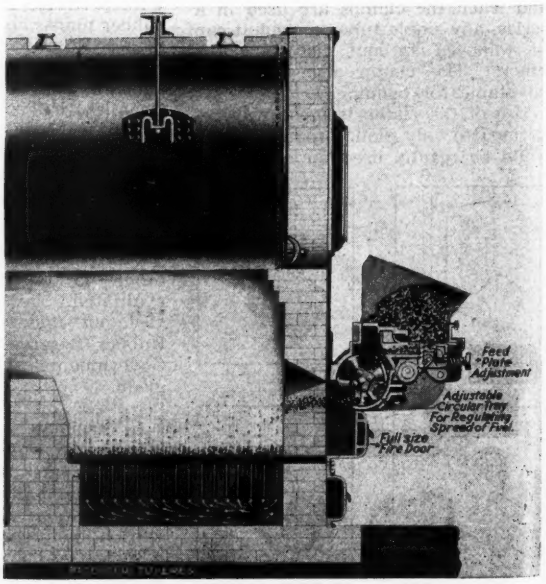


Fig. 2. This is an underthrow type of coal spreader for firing an HRT boiler

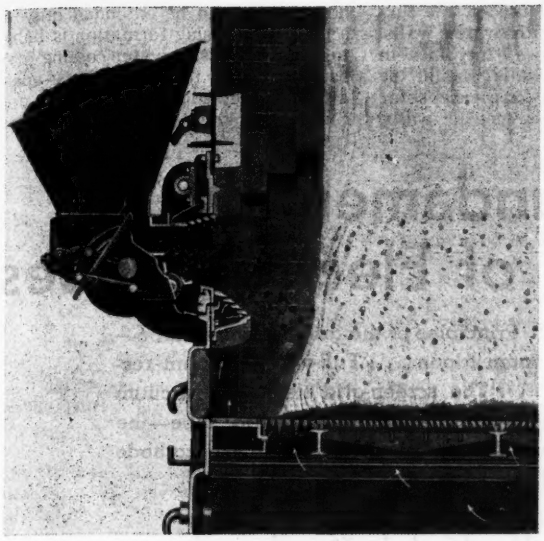


Fig. 3. Here is an overthrow type of coal spreader with stationary grates

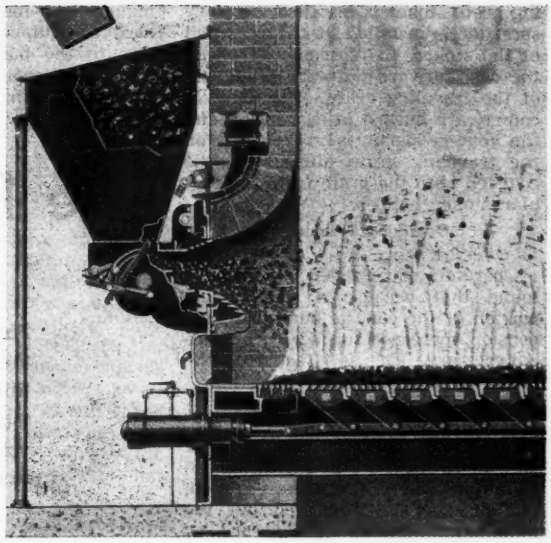


Fig. 4. Power dumping grates are used with this overthrow type of coal spreader

6 shows a side elevation of such a stoker with 6 rotary spreaders installed under a bent tube type of boiler which has carried loads up to 225,000 lb steam per hr burning Indiana coal averaging 10,500 Btu per lb. The average daily efficiency has been about 83 per cent with a combustion rate of about 65 lb of coal per sq ft of grate area.

Another manufacturer has developed a modification of the foregoing construction. In a boiler setting in which a conventional type of travel-

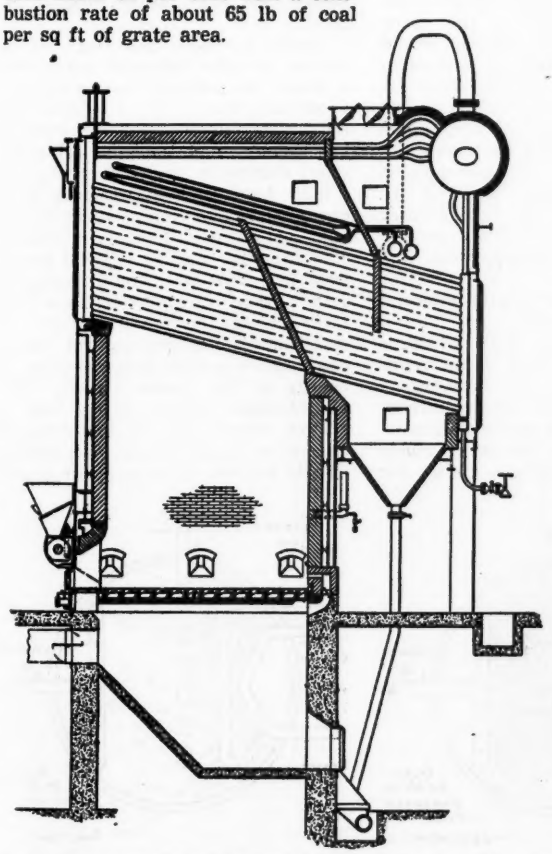


Fig. 5. This sectional header boiler of 19,760 sq ft is fired with underthrow spreaders and power operated dumping grates

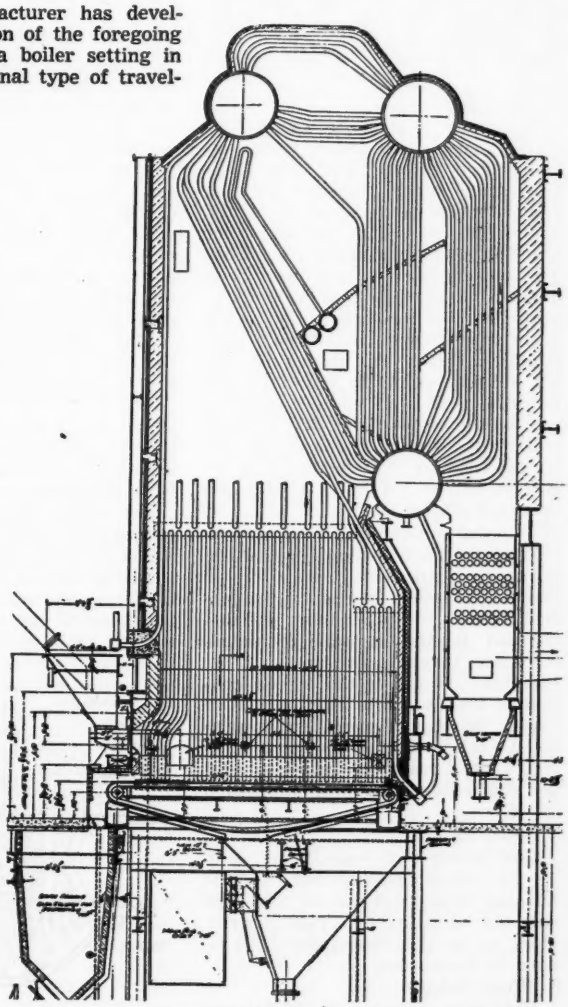


Fig. 6. This boiler has carried loads of 225,000 lb steam per hour fired with six rotary spreaders and a special design of slow speed traveling grate stoker which discharges the ash at the front

ing grate stoker is installed, a rotary spreader is installed at the rear end of the stoker, the spreader throwing the coal forward onto the front end of the traveling grate. The fines, of course, are burned in suspension and the coarser particles are burned on the traveling grate along with the coal fed onto the grate from the regular stoker hopper.

Operating Technique

1. *Overfire Air*

Operators of spreader stokers have found that because a considerable portion of the cone is burned in suspension, increased furnace turbulence is necessary. This is effected by the use of overfire air jets.

2. *Primary or Under Grate Air*

Primary air for combustion supplied to the ash pit may be either natural or forced. In the layer installations where forced draft is used, the air may be preheated but the temperature should be governed by the fusion point of the ash in the coal.

Forced draft air pressures seldom need to exceed 2 in. water pressure. Automatic combustion control should be installed in order to maintain the proper ratio of air to coal at all loads.

3. *Cleaning Grates*

Stationary grates are usually installed under small boilers where the combustion rate is low. For large boilers and higher burning rates, to permit more rapid cleaning of the grates, air or steam cylinders are used for power dumping of the grates. The air chamber in the ash pit is divided into sections to provide a separate chamber for each section of the grate supplied with coal from a particular spreader. This means that the air and coal supply to any given section can be shut off without interfering with other sections and without materially increasing the excess air in the furnace. A section can be cleaned in 2 to 3 minutes with power operated grates.

4. *Fly Ash Problems*

Since the finer particles of coal are burned in suspension, a considerable quantity of ash and cinders are carried through the boiler tubes and discharged to the atmosphere unless steps are taken to prevent such occurrence. As a rule the carbon content of the fly ash is high enough to justify the cost of means for returning the ash to the furnace for reburning: Cinder traps, cyclones and cinder separating fans have all proved effective.

5. *Coal Sizing*

Coal sizing may vary from ¼ to 1¼ in. screenings, depending on the burning characteristics of the coal and the combustion rate desired. Most of the particles under 1/16 in. burn in suspension.

6. *Heat Release*

Heat releases below 35,000 Btu per cu ft of furnace volume have been found to give the best results but higher rates may be used if the furnace is equipped with water walls. Due to the burning of the fines in suspension, water walls should be used in all installations except for small boilers. Water cooled walls, however, should be extended only to a point where slag formation is liable to occur. Excessive water cooling may be detrimental to good furnace operation by retarding combustion and causing smoke.

The Fundamentals of Electron Tubes

Part III. Principles of the grid-controlled tube—the vacuum triode . . . Full-wave vacuum rectifiers . . . The screen-grid tube—the vacuum tetrode . . . The suppressor grid tube—the vacuum pentode . . . Principles of the cathode ray tube

By Ralph B. Immel

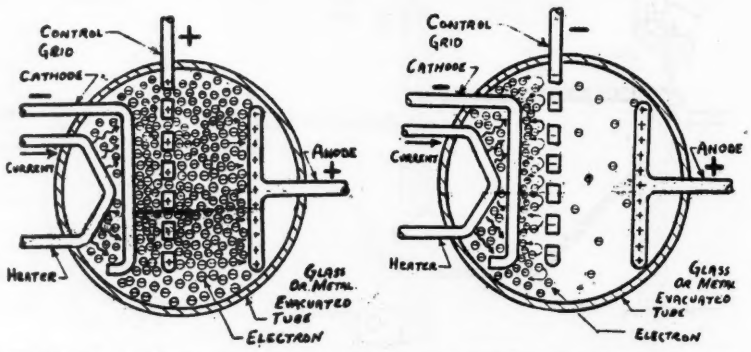
Control Engineer, Westinghouse Electric Corporation
East Pittsburgh, Pa.

IN 1907 DE FOREST inserted a metallic grid between the filament and the anode of a two element tube. It was found that the electrostatic field of a negative grid partially neutralized the electrostatic field of the positive anode. The net result is the same as an increase in the space charge and the anode current would decrease from the value it was when the grid was at zero potential. A positive potential on the grids assists the field of the anode. Hence, it corresponds to increasing the anode potential; but due to the proximity of the grid to the cathode the grid potential change will produce greater effect on the electron flow than the same change in anode potential. Figures 10 and 11 illustrate the effect of a positive and negative grid potential upon the anode current.

The three element tube which is known as a *triode* acts like a regulating valve as the grid can very effectively control the anode current flow by a change in grid potential.

Figure 12 shows the static anode current vs anode voltage curves for a given value of grid potential. This set of curves shows very clearly that for a given anode voltage that a change to a more negative grid voltage reduces the anode current as the electrostatic field partially neutralizes the electrostatic field of the anode.

Figure 13 shows the static anode current vs grid potential curves for a given or constant anode voltage. From these curves it can be seen that the anode current may be changed the same amount by a relatively small change in grid voltage (anode voltage held constant) or by a large change in anode voltage (grid voltage held constant). This grid control characteristic may be utilized for an amplifier, as a very small change in grid voltage is equivalent to a very large change in anode voltage. A small amount of grid control energy can control a very large amount of energy in the anode circuit. The amplification factor of a tube μ (Greek letter mu) is the ratio of change in anode voltage to a change in grid voltage in the opposite poten-



Figs. 10 and 11. Effect of positive and negative grid potentials upon the anode current of a triode

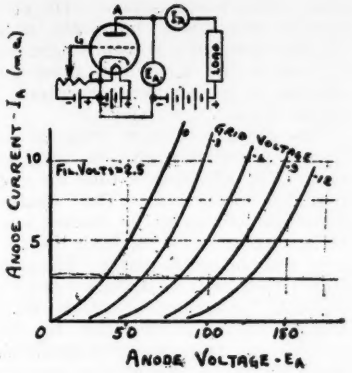


Fig. 12. Static anode current vs. anode voltage curves for a given value of grid potential

tial to hold the anode current at a constant value. When either the anode or grid voltages are changed, the other potential is maintained at a constant value. In Fig. 13, for the curve with a grid potential of 5 volts and an anode potential of 100 volts, if the anode potential is increased to 125 volts, the grid potential must be made 3.2 volts more negative (—5 to 8.5 volts) to hold the anode current constant. The ratio of 25 volts to 3.2 volts gives an amplification factor or 7.8. A typical triode tube may have an amplification factor 20 to 30.

This tube may also be thought of as a variable resistor. The grid potential can control the anode current just as a variable resistor can be manually controlled to vary the current in the circuit. If an alternating current radio signal is applied to the grid, an amplified alternating signal

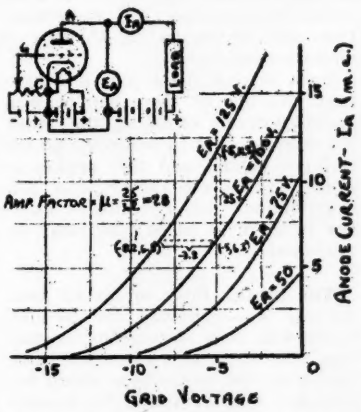


Fig. 13. Static anode current vs. grid potential curves for a given constant anode voltage

will be superimposed upon the d-c anode voltage in the anode circuit. The amplified signal will not be distorted if the range of plus and minus grid voltage operates upon a linear or straight portion of the curves shown on Fig. 13. The grid takes little or no energy from the circuit whose voltages are amplified. Triode tubes are sometimes known commercially as Pliotrons. Fundamentally a tube does not amplify a current, but amplifies voltage applied on the grid which may be translated in terms of current.

Full Wave Vacuum Rectifier Tube

Figure 14 shows a three element full-wave rectifier tube. In this tube the third element is an anode in place of a grid. This tube is not grid controlled and is the equivalent of two single diode tubes built into one unit. This tube is convenient and economical to use in low d-c power units as only one heater is used for both anode circuits. At a given instant of time only the positive anode will attract the electrons and allow current to flow in the external circuit. The negative anode will repel the electrons and prevent current flow in the external circuit connected to that anode.

Screen Grid Tube—Vacuum Tetrode

The capacitance between the grid and anode elements is of little consequence when the tube is applied in

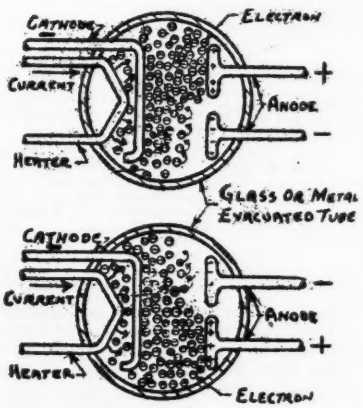


Fig. 14. Diagrams of the 3-element full-wave rectifier

low frequency circuits. However, when it is operated at high frequencies in the order of several hundred kilocycles, the interelectrode capacitance between the grid and anode of a triode is detrimental to high fidelity amplification. At high frequencies this capacitance has a very low impedance and will couple the anode and grid circuits together and produce unstable operation. If the tube is used as an amplifier, the output will probably be distorted. The feedback of energy from the anode circuit to the grid circuit may continue until oscillation occurs. When the tube and its circuits oscillate, the tube is of very little value as an amplifier.

The capacitance between the grid and the anode of a triode vacuum tube can be very effectively reduced by the addition of a second grid, called a screen, between them. This tube is called a *tetrode* as it has four elements. The screen acts as an electrostatic shield between the

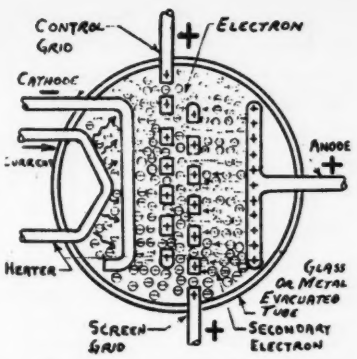


Fig. 15. The screen-grid tetrode

grid and anode and reduces the grid-to-anode capacitance. This tube is better than a triode as the anode resistance and amplification factor of the tube are also increased. For typical tetrode tubes the grid to anode capacitance may be reduced from 16 micromicrofarads for a triode tube to .007 micromicrofarads for a screen grid tube. The anode resistance may also be increased from 1000 ohms for a triode tube to over 1,000,000 ohms for a tetrode. A typical tetrode tube used as a radio frequency amplifier may have an amplification factor of 780. The screen must be maintained essentially at ground potential as far as the high frequency voltages are concerned, in order to act as an effective screen or shield between the grid and plate.

As shown by Fig. 15, the control grid controls the current flow similar to the action of the grid in a triode tube. The screen grid is usually operated at a positive anode voltage and at a value less than the anode voltage. The screen supplies the electrostatic field for attracting electrons from the cathode. As there is a comparatively large space between the screen grid wires, most of the electrons pass through the screen to the anode. The anode current is almost independent of the anode voltage and is predetermined to a degree by the screen voltage.

As the screen is usually operated at a fixed voltage and since the anode

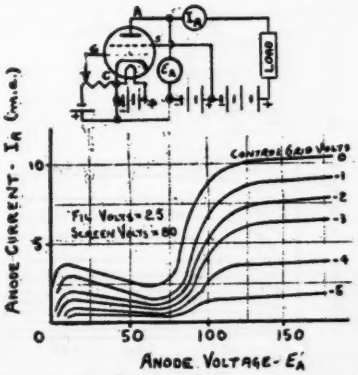


Fig. 16. Typical curves of a screen-grid tube showing the negative resistance characteristics

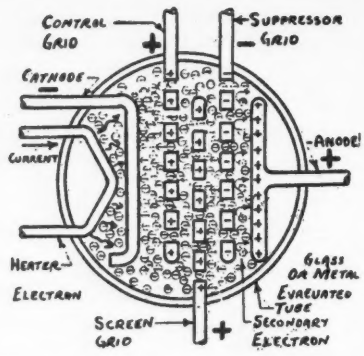


Fig. 17. The pentode or suppressor-grid tube

voltage may vary, the anode voltage for some circuit applications may at some instant of time be less than the screen voltage. Secondary electrons liberated from the anode by the electrons from the cathode striking the anode will be attracted to the screen as shown by Fig. 15 when the anode voltage is less than the screen potential. The effect of the screen attracting the secondary electrons is to cause a current to flow from the anode to the screen which results in the tube having a "negative resistance" characteristic. In a certain voltage range the total or net anode current decreases with an increase in anode voltage. Fig. 16 shows the negative resistance characteristic for a certain type of tetrode operated in the range of 10 to 75 volts anode potential. In general, a tube of this type should not be operated so that the anode voltage will be less than 90 volts. The tube should not be used as an amplifier if the anode voltage is between 0 to 90 volts. The negative resistance characteristic is sometimes utilized in a Dynatron-oscillator. This type of oscillator is not as widely used as other types are usually more stable and reliable. This tube characteristic also has a limited application in trigger circuits.

Suppressor Grid Tube—Vacuum Pentode

The undesirable negative resistance characteristic of the tetrode tube may

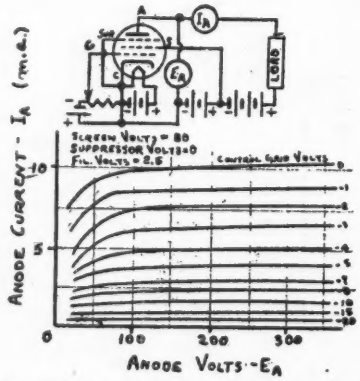


Fig. 18. Characteristic curves of a typical pentode tube

be eliminated by the introduction of a third grid known as a suppressor grid between the screen and the anode. The suppressor grid is usually operated at the same potential as the cathode. As the tube has five elements, it is known as a pentode. The secondary electrons emitted from the anode are repelled by the negatively charged suppressor grid as shown by Fig. 17 and returned to the anode. The suppressor grid proves additional shielding which results in a still higher anode resistance and amplification factor. Pentode tubes used in television amplifiers may have amplification factors as high as 6750. Both the screen and suppressor grids are made of every fine wires which are spaced relatively far apart. This wire size and spacing permits most of the electrons to go between the grid wires in their flight from the cathode to the anode.

Figure 18 shows the characteristic curves for a typical pentode tube. From this set of curves it may be

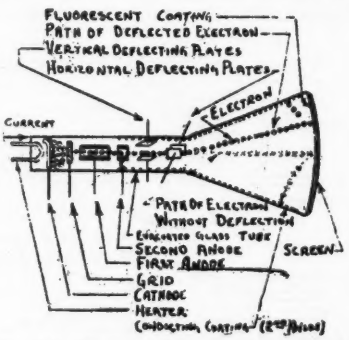


Fig. 19. Diagram showing the constructional features of the cathode ray tube

seen that the anode voltage can be as low or lower than the screen voltage without seriously affecting the amplification characteristics.

High vacuum triodes, tetrodes and pentodes are all classed industrially as, photrons.

Cathode-Ray Vacuum Tube

The cathode-ray tube is one of the most useful and important tools available for studying and observing periodic and transient electric wave motions. The electrons in a cathode-ray tube are emitted by thermionic emission from the cathode and focused and accelerated by grids and anodes in the tube. In the tube shown by Fig. 19 the grid controls the density of the electron stream and provides a means for controlling the intensity of the luminous spot or wave shape on the screen. The first and second anodes act as a converging lens and gives the electron beam a sharp focus on the screen. The second anode is usually operated at a high potential with respect to the cathode and this potential will determine the final electron velocity. The enlarged end of the tube is coated with a fluorescent material which will emit light during an electron stream bombardment. The particular fluorescent materials used usually flow with a visible light for a time period depending upon the velocity of impact and concentration of the beam.

The electron stream may be deflected electrostatically or magnetically. Fig. 19 shows a tube for electrostatic deflection. The electric wave phenomena to be studied may be applied to either or both the vertical and horizontal plates. The electron stream will be deflected proportional to the applied potentials. Electronic sweep circuits may be employed to provide time-amplitude wave forms. A cathode-ray tube for electrostatic deflection control is more sensitive and usually employs a more simple control circuit than magnetic deflection.

The electron stream has no apparent inertia and can follow waves of unusually high frequencies. This tube can be employed for observing hysteresis loops, power phase distortion, circuit breaker operating characteristics, radio voice modulation, and for television reception.

(To be continued)

MAINTENANCE in a modern factory or other large building involves not only one function but really five. These are: 1, Selection and application of proper equipment; 2, Responsibility for the continuous and economical operation of the electrical system; 3, Periodic and systematic inspection and testing of apparatus and the entire electrical system; 4, Responsibility of various degrees depending on the size of the plant for adequate design and layout of electrical construction for modernization and expansion; 5, Control of maintenance costs.

Each one of these jobs is important. No one of them can be neglected without effecting the other. All must be kept in balance. No one can get behind and this applies as much to the contractor who does maintenance under contract as to the head of a plant electrical department.

* * *

THE INTAKE filter of an air compressor was removed for cleaning which was done by washing in gasoline. The filter was immediately replaced on the compressor which was returned to operation. The mixture of oxygen and gasoline fumes was apparently ignited by the heat generated within the compressor causing the tank to explode. Fortunately no one was injured. Air filters should be allowed to dry thoroughly before they are put into place or should be washed in a safe solvent.

* * *

COPPER should not be used for electric strip heater connections. Use steel, nickel or monel metal because copper will oxidize and loosen the connection.

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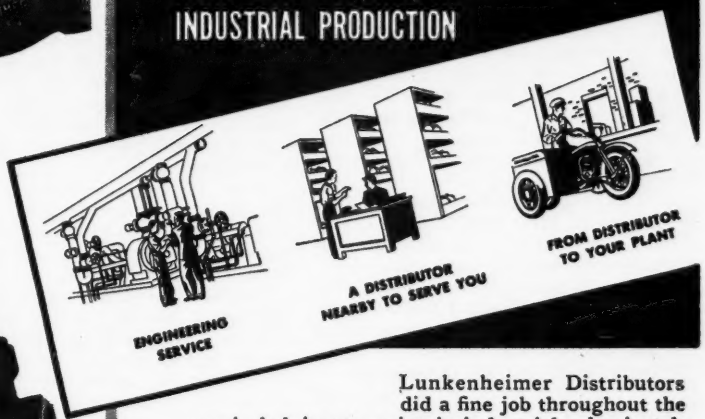

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LETTERS AND COMMENTS

Bill Heiwig Lives and Learns—About Condensers and Things

NOT LONG AGO I was called into a steam plant driven by an 18 x 36 x 30 cross-compound non-condensing steam engine, which was well loaded. The engineer's complaint was that "his engines were dragging" and he was at a loss to know what was wrong. I asked him if he had been playing with the valve setting for they pounded heavily. His answer was no.

So I asked him how long had his trouble been coming on. He answered it appeared to him that something had been wrong for quite a spell. I asked him if he had taken any cards lately and he said no, as he had taken his reducing motion off to repair it and had not placed it back on the engines yet.

I suggested that when he shut down in the evening, he should replace the motion and we would take a few cards the following day. To this he agreed and the following morning we indicated the engines.

After we had a few cards, I asked him if he saw anything wrong and he said it looked like his back pressure was a little high. But he could not understand it as he was sure the condensers were in good shape.

When he said condenser, my mouth flew open. I was sure I had not seen any condenser and I sure wanted to know where it was located, as everything looked non-condensing to me.

So I asked him where his condenser was located and he said on the roof. I suggested that we go on the roof and look it over. He said OK, only we have two instead of one. It was getting more interesting all the time.

As we started for the roof I was doing a lot of thinking and when we arrived on the roof I was still in a fog as I could see nothing that looked like a condenser to me.

I said to him, "Where is your condenser?"

And pointing to what I thought was exhaust heads, he said, "This is them."

Well, was my face red! I thought of the old saying—never too old to learn. Well, I just stood and looked at them, not an ounce of steam coming out of them. I thought to myself, well, old boy, what are you going to say now?

After I had come out of my trance I said to him, "I don't believe you have a condenser because I cannot see any visible source of condensing water supply." He said, "Oh yes," and pointed to a 1-in. pipe.

Then things began to happen. I said, go get me a hammer so that I can sound the bottom part of your condensers. After we had the hammer, I tapped the bottom of the so-called condenser and it was solid. I said to him, "Your trouble is that you are all scaled up and your exhaust steam cannot get away."

These so-called condensers were located on top of an old two-flue boiler from which flues had been removed and it had been made into a heater and storage tank. The feedwater discharged from this heater to a vertical open type feedwater heater and then to boiler feed pump. Although the vertical feedwater heater had an exhaust pipe from it, it was not large enough to handle all the exhaust from the engines.

I suggested that when he closed down, we remove one of the condensers and take a look at it. To this he agreed and after closing down, we removed the bolts from the top of the condenser and tried to remove the inside, but it was tight. After tapping around the bottom we were able to pull the insides out.

And talk about scale!—well, he had it. The shaded part o Fig. 2 will give you an idea of how it was. The 8-in. exhaust pipe had a 3-in. hole in it and up to the first baffle it was solid.

After we had one cleaned I suggested to the engineer that we remove the bottom baffle and run the so-called condenser as an exhaust head; to this he agreed.

The next morning I went into his plant and before I could ask any questions, the smile on his face told me we had hit the jack-pot. The only thing that he could see that was wrong was that water was blowing all over his roof from the head that we had cleaned. I told him that on the week end we would cure his trouble.

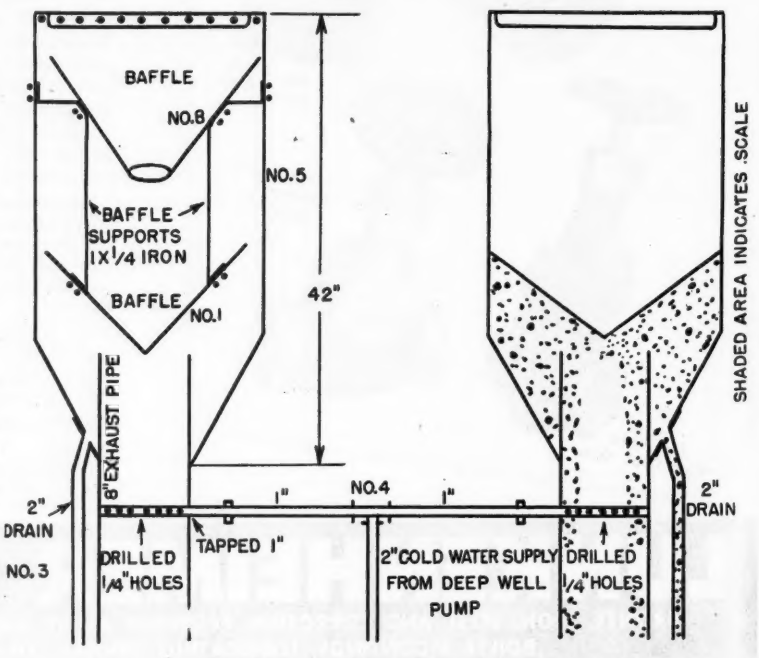
As they were not going to operate on Saturday this gave us two days to clean up things and rearrange the water inlet to an old boiler feedwater heater. After we had made the changes and started up he was a much pleased engineer. No water was blowing upon his roof and his indicator cards showed normal back pressure.

To give the readers some idea as to how these "condensers" were constructed, referring to Fig. 1, No. 5 is the condenser proper made of 20-gage galvanized iron, No. 4 is the water supply from a deep well pump and is not treated. The 1-in. pipe into the 8-in. exhaust line was drilled with ¼-in. holes so as to spray water into the outgoing exhaust steam. No. 1 and No. 8 are baffles, No. 8 had a 3-in. hole in the bottom of it while No. 1 was solid. No. 3 is a 2-in. drain back to heater. The shaded part of Fig. 2 is scale as found.

Changes made were to remove all of the No. 4 and plug tapped openings in the 8-in. exhaust pipe, then install a 2-in. perforated feedwater pipe suspended from the top of the old boiler feedwater heater and connect same into the 2-in. deep well pump discharge. Remove baffle No. 1 and close opening in baffle No. 8. Install a Manzel feedwater treatment pump on the deep well pump so that we could feed water treatment into feedwater discharge line regularly.

To date the operation of plant after these changes has had no trouble whatever and the management is well pleased.

WM. "BILL" HEIWIG
Seymour, Indiana



Figs. 1 and 2. Cross sections of the "condensers"

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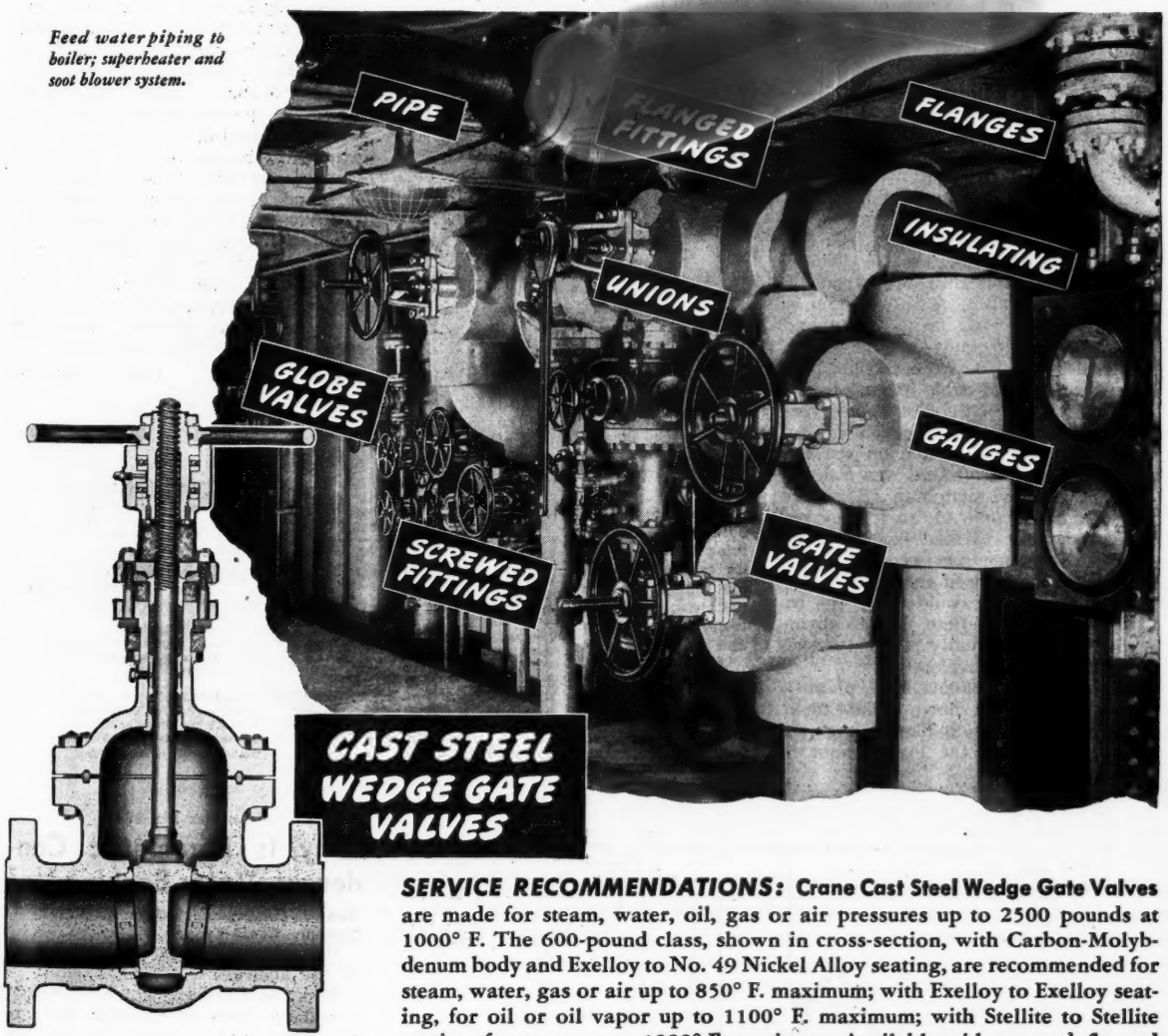
Feed water piping to boiler; superheater and soot blower system.



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Questions And Answers

Question No. 309

Why Doesn't This Power System Operate Right?

HEREWITH IS a sketch of a rural power layout which has given the man who installed it a little trouble. He has appealed to me for advice and as I am unable to locate the trouble for him, I am passing on the question to you.

The sketch is self-explanatory of the method now used to keep the system in operation. As originally laid out, it was intended that each leg of the generator was to supply (A), (B) and (C) respectively, as the load is very evenly divided. However, in the course of installing a water pump at location (B), with the fuses out and the neutral grounded, a feed-back was discovered between the line and the lead-covered cable leading to the pump. A voltmeter connected between these points reads 55 v.

By pulling the switch on the circuit to (A), the ground was cleared. By pulling the switch to (B), there is no ground on (A), so it does not seem possible to feed back through that transformer or line.

It was discovered that each phase of the generator could carry the total load at this time, but to divide the load as originally planned causes the ground to develop.

As explained above, the plant is now operating as shown in the sketch, but what we would like to know is: Why is it that the load cannot be divided as planned and utilize all three phases of the generator?

The thing that has me puzzled is the relationship that circuit (A) seems to have to the situation beyond the fuses at (B).

Kansas City, Mo. H. N. C.

Question No. 310

How Does Level Indicator Work on Brine Cooler?

PLEASE SEND ME a description of an ammonia level indicator as applied to a horizontal shell-and-tube brine cooler. We have them installed on our coolers but they do not function properly. What size pipe and fittings will serve best to show the "frostline" or liquid level in the coolers?

Buffalo, N. Y. W. M. H.

Oil Accumulation May be Causing the Trouble, says Holman

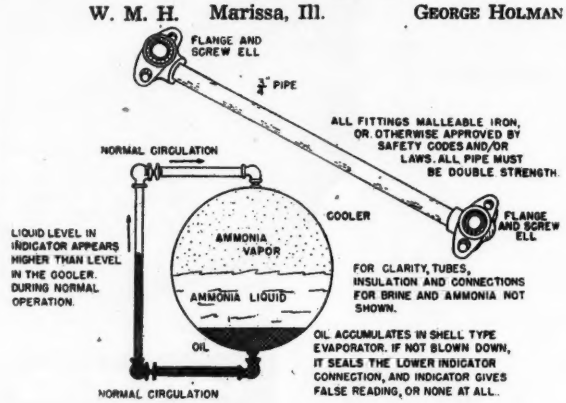
AN INDICATOR for such a brine cooler may be made of pipe and proper connections as shown in the accompanying sketch.

If a cooler is of large diameter, the pipe should be 1-in. If the cooler is of small diameter, or if the indicator can be made short, ¾-in. pipe is an ideal size. Pipe smaller than this gives a progressively higher indicated level than the true level in the vessel.

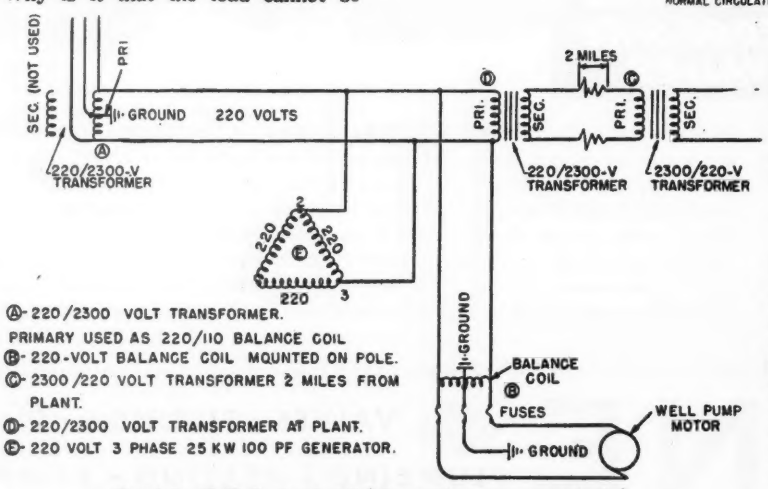
If W. M. H.'s present indicators don't work, the cause is probably an accumulation of oil sealing the lower connection, as shown.

During the normal off cycle, the residue liquid in the cooler (or evaporator) and that in the indicator will remain at the same level only when the suction pressure has risen high enough to check evaporation. With the fall of the suction pressure, however, the liquid in both indicator and evaporator begins to boil. Although evaporation tends to lower the level of liquid in the indicator, constant feed from the lower connection maintains the liquid level. Upward circulation, however, carries the cold vapor from the indicator back through the evaporator to the suction line. This upward movement raises the frost line somewhat.

Marissa, Ill. GEORGE HOLMAN


FLANGE AND SCREW ELL
¾" PIPE
ALL FITTINGS MALLEABLE IRON, OR OTHERWISE APPROVED BY SAFETY CODES AND/OR LAWS. ALL PIPE MUST BE DOUBLE STRENGTH.
NORMAL CIRCULATION
COOLER
FLANGE AND SCREW ELL
LIQUID LEVEL IN INDICATOR APPEARS HIGHER THAN LEVEL IN THE COOLER DURING NORMAL OPERATION.
AMMONIA VAPOR
AMMONIA LIQUID
OIL
FOR CLARITY, TUBES, INSULATION AND CONNECTIONS FOR BRINE AND AMMONIA NOT SHOWN.
OIL ACCUMULATES IN SHELL TYPE EVAPORATOR. IF NOT BLOWN DOWN, IT SEALS THE LOWER INDICATOR CONNECTION, AND INDICATOR GIVES FALSE READING, OR NONE AT ALL.
NORMAL CIRCULATION

Sketch by George Holman, showing how indicator for brine cooler should be made of pipe and fittings and how oil can seal off lower connection and cause incorrect indication



Sketch by H. N. C. showing lighting system as now connected

Answer No. 294

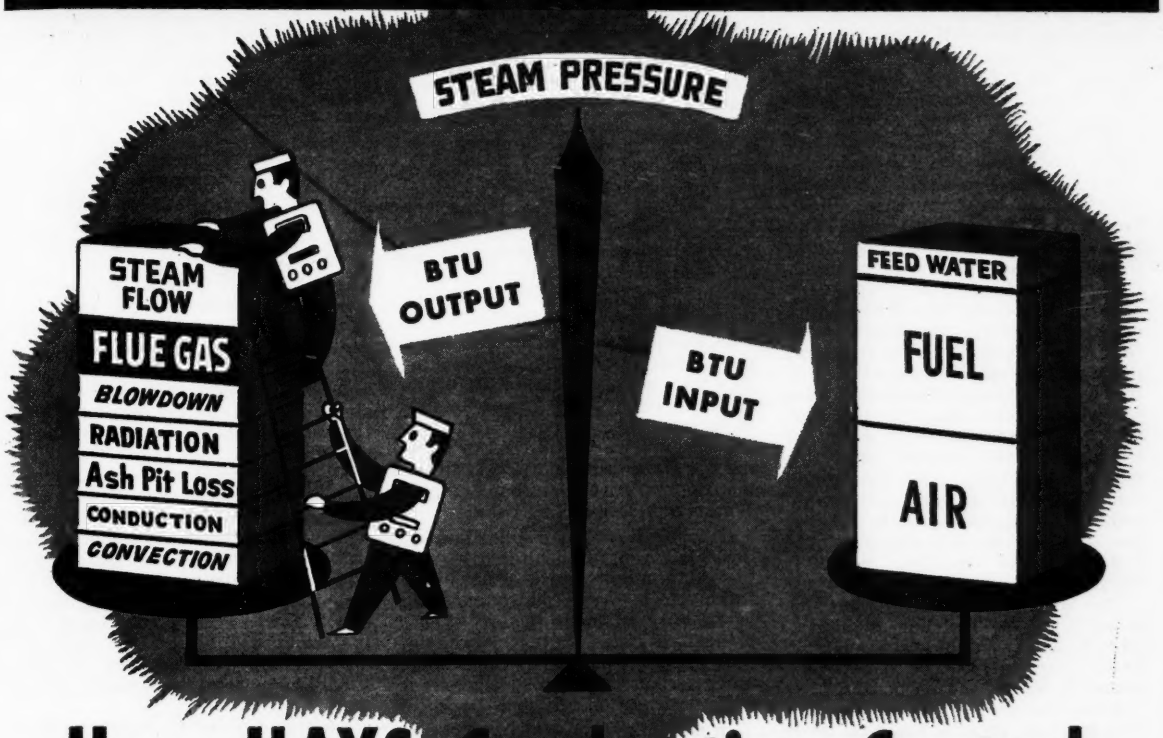
Why Is Barometric Condenser Water Backing Up?

Analyze Condensate, Determine Water Quantity, Check Trap

Possibly one of the following may be the answer:

STARTING from the hot well, water would not back up through the tail pipe from the hot well unless the hot well was totally enclosed and a pressure was built up high enough above atmospheric to raise the water 34 ft. Even then this would not be possible, in this case, unless the overflow to sewer was blocked or too small to begin with and the capacity of the cooling tower pump was too low, due to wear or blocking of suction pipe, etc.

ELECTRICAL OPERATION IS AS MODERN AS POST WAR INDUSTRY MUST BE!



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The most comprehensive, most understandable explanation of automatic combustion control ever compiled. Ask the Hays representative to show it to you.

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3. What results can be expected of each.
4. Elements of a *good* control system.
5. Elements of a good controller
6. *Coordinating* the controllers.
7. Selecting the best system for your needs.
8. How Automatic Combustion Control operates.
9. How each individual controller operates.
10. How controllers are calibrated and adjusted to fit requirements.
11. How controllers are stabilized to prevent hunting or over-travel.
12. Typical installations of Automatic Combustion Control.

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- A furnace draft controller operates to hold furnace draft constant

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However, if the hot well was totally enclosed, except for the sewer outlet and tower pump intake, than any lowering of the rate of water leaving the hot well below that of the condensate and cooling water leaving the condenser, would probably result in flooding of the condenser, due to the increased resistance offered to the free flow of water from the tail pipe.

Any obstruction at the tail pipe outlet would have the same effect, but H. G. S. has stated that the tail pipe is clean, although I do not know if he checked the tail pipe outlet.

It is possible that the trap in the exhaust pipe from the turbine is not working properly. The point where this trap is located is an excellent place for water to accumulate. If this was not constantly drained, then the water would build up to a point where it would have the effect of shutting off the exhaust, until this water was slugged out. This would tend to stop the turbine, as it would require approximately 9 lb exhaust pressure to push this water up into the condenser through the 20-ft riser.

The accumulation of water at this point in the exhaust line might possibly be increased due to a defective baffle plate at the exhaust pipe where it enters the condenser.

From the drawing it appears as if this trapping point is less than 34 ft above the hot well level. If the discharge from this trap was into the hot well and at a point below the surface of the water, then if it had no check valve, or if the one it did have leaked, then it would be possible for the water to siphon back into this exhaust line. This water would then accumulate, with results probably as described by H. G. S. This would then be a case similar to that described on pages 48 and 49 of the April issue, except that the turbine would not have to be shut down for this siphoning to take place.

In answer to the question as to whether too much water can be used on a barometric condenser, I would say yes, because the maximum rate of flow through the tail pipe is more or less fixed by gravity, while the amount of water through the inlet can be increased, even with restricting orifices, by raising the inlet water pressure above that called for in the condenser design.

I do not know whether this is possible with H. G. S.'s condenser water pump or not, but if it is, then the flooding of this barometric condenser may be caused by one or more of the following:

1. From the drawing, this condenser appears to be of the baffle plate type. Possibly one or more of these baffle plates may have corroded or eroded in such a manner that the distribution of water and steam is not as good as before, resulting in a lowering of the condenser efficiency with consequent increased amount of water to maintain the same vacuum.

2. Since the turbine in this problem is driving the refrigeration machine, the load on the barometric condenser and the refrigeration condenser increases at the same time and vice versa. Possibly due to a heavier refrigeration load than formerly, the temperature of the water leaving the refrigeration condenser may be out of proportion to the temperature of the water required to maintain the desired vacuum at this load. This would require an increased amount of water, possibly resulting in flooding of the condenser.

3. Possibility of refrigerant from the refrigeration condenser leaking into the cooling water. This would probably result in a larger amount of gases to be removed from the condenser. This would tend to lower the condenser efficiency, resulting in the use of more water than the condenser was designed to handle.

It is also possible, depending on the refrigerant used, that a leak of this kind might cause serious corrosion of the baffle plates resulting in the use of more water as explained in No. 1. This contamination of the condensate could have other serious results, especially if it were used for boiler feed.

In summing up—the condensate should be analyzed, the amount of cooling water used should be determined, the exhaust line trap operation and capacity should be checked, and if none of the above are found to be at fault, I would open up the barometric condenser.

The manufacturer of this barometric condenser should also be consulted.

St. Louis, Mo. JESSE L. ERISMAN

Check Baffles and Change Exhaust Piping

IN MOST CASES, the baffle rings in this type condenser are only tack welded. This will generally break off from the condenser wall and turn the ring upward. That lets the water slide down the condenser wall into the 24-in. opening. A slight change in the exhaust piping, as shown on H. G. S.'s diagram, will overcome his trouble.

Brooklyn, N. Y. S. KULICH

Check Trap, Baffles, Tail Pipe Leaks

IN A PROPERLY DESIGNED barometric condenser installation, the tail pipe is of ample size to readily remove the mixture of condensate and injection water. It is apparent that this is not the problem that H. G. S. has, since the installation has operated for approximately two years without difficulty.

It appears that the exhaust line trap is not in operating order, permitting condensation to accumulate in the turbine exhaust casing. If the trap discharge is submerged in the hot well or other vessel, it is possible that, with faulty trap operation, water may be forced back into the exhaust line from the point of discharge line submergence. H. G. S. should be sure he is using a vacuum trap.

Another possibility would be that through chemical action, condenser baffle plates had failed and, in falling, had lodged over the tail pipe inlet, partially restricting the flow. This would permit the condenser to fill to the exhaust line level, with resulting overflow to turbine.

It would be well to go over the tail pipe for leaks, since, a leak at this point results in a column of aerated water in the tail pipe which will stand at a much higher level.

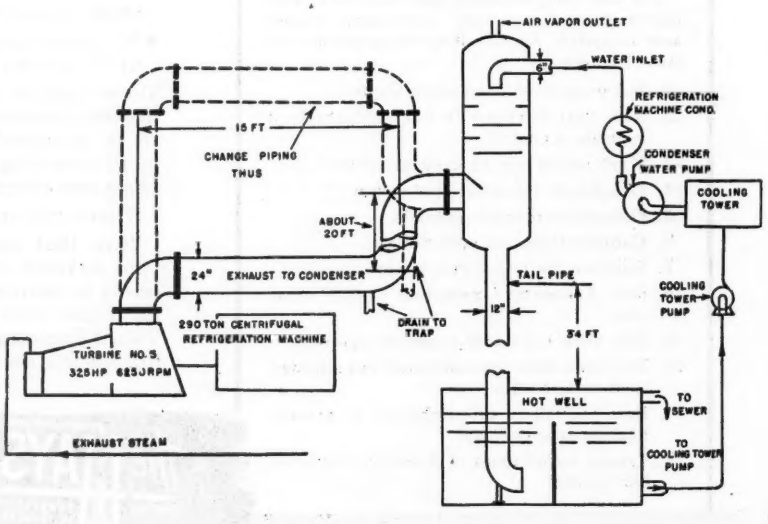

Diagram of H. G. S.'s barometric condenser installation, showing in dotted lines how S. Kulich proposes to change exhaust piping

Please Note These Facts . . .

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2. Since all AJAX Gaskets are constructed for specific operating pressures, they assure a higher safety factor. Internal gasket construction is modified for each major pressure group without the necessity of increasing flange area.
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When you specify AJAX, you get boiler gaskets that are engineered for long service life.

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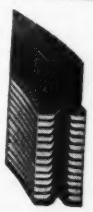

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Note on this cutaway drawing, the small air space under each U-groove in the metal ply

There are twin strips of asbestos filler between each spiral thickness in the AJAX Gasket which cannot meet in the center under the wedge-like groove. Therefore a "breather-space" is preserved in the heart of the gasket which assures its automatic reaction to mechanical compression, to internal pressure variation, and to temperature changes.

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The above cutaway is the AJAX SR Compression Gauge Flange Gasket

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Page 2H-8
Power Plant File

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With information as to vacuum during the period at which turbine receives water slugs, and injection water pump name plate rating, a more definite answer could be given.
Melrose, Mass. W. P. BARNARD

Answer No. 296

Should These Turbine-Generators Be Installed or Should Power Be Bought?

Engines, Not Turbines, Are Indicated Here

A STUDY OF the conditions as presented indicates in my opinion that a turbine-generator set is definitely not suited for the operating conditions described.

It is easy to accept the viewpoint that if a certain volume of steam is required for heating purposes and the turbine-generator set is located between the high pressure supply and the low pressure required for the heating system, the energy thus made available from a turbine-generator set is energy obtained at no additional cost for fuel, and this is true.

The increased cost in operating the plant to generate this energy would be the interest on the invested capital for the turbine-generator and accessories, depreciation charges, insurance, maintenance, and operation costs, etc. It is easy to balance these first charges against the electricity generated and assume that a profitable result has been established and on that basis this may be true. This does not, however, justify inefficient power plant operation and to operate a turbine-generator set as outlined in Question No. 296 is, in my opinion, highly inefficient.

It is evident that the building heating load is much less than the power load, therefore considerable exhaust steam must be wasted to the atmosphere. If that is true, then the turbine is operating at a high steam rate per horsepower or per kilowatt-hour, because it is being operated against a back pressure of 5 or 6 psi. This, therefore, means that an excess volume of steam is being exhausted or wasted.

A steam turbine is, without question, one of our most efficient means of driving electric generators, provided the proper operating conditions prevail. These are high boiler pressure with a suitable amount of superheat, and high-duty condensing equipment, thus establishing a maximum pressure range between inlet and exhaust on the turbine. Any reduction in these two conditions, whereby the total range between initial pressure and exhaust brings about a reduction in this range, increases the steam consumption per kilowatt-hour.

There are two conversion processes to be considered; first, that the steam generating unit is performing at the highest possible efficiency for the type and size in use; second, that the conversion of this steam into electricity is accomplished also at the highest rate of efficiency possible, and that to do this we must select the type of equipment that is suitable to the operating conditions to accomplish the result desired.

It is my opinion that unaflow engines of the multi-cylinder and vertical type would be the ideal units for the requirements outlined. Unaflow engines are even more fool-proof than turbines. They will operate under the conditions as stated much more efficiently than a turbine, thus their steam consumption per kilowatt-hour will be less than that of a turbine. There will be less steam to generate and less exhaust steam to be wasted; therefore, the conversion of steam costing 21.9 cents per thousand pounds into electricity by means of a unaflow engine will produce more kilowatt per dollar spent for fuel than would be the case with the turbine. It is further necessary that we follow this procedure because the heating load is less than the power load, therefore even the unaflow engines should exhaust more steam if operated at full load than would be required to heat the building.
West Hartford, Conn.
HARRY W. BENTON

Consider Spray Pond or Tower, Boiler Limitations, Types of Turbines

HAS C. F. M. made a thorough survey of other condensing problems other than river water? Has he considered the possibilities of using a spray pond or a cooling tower for recirculating water through the condenser?

What are his boiler limitations? Are the boilers of sufficient horsepower capacity? Are they superheater equipped? Is the steam pressure high enough to operate the turbines?

Those are the thoughts that entered my mind. We are operating two turbines in this plant and I will, of course, base my answer on the assumption that the steam generators are of ample size, that they are superheater equipped and the steam pressure is at least 200-psi.

Of course, no two plants are alike and each plant has its own problems, such as the location, the price of fuel, and whether the management is willing to buy the most efficient turbine for the needs of the plant.

In our case, through an error a single-stage turbine was installed some time ago, whereas we should have bought a turbine of about 10 or 11 stages.

We ran this steam hog for about a year at only 200-kw output. The generator was designed for 500-kw. That was one time when turbine power almost ruined us. We had so much back pressure at 200-kw load that we were constantly exhausting into the atmosphere.

Then we got another chief. The first thing he did was to bring to the management's attention how much fuel they were throwing out of the exhaust. They finally saw the light and bought another turbine-generator. This time, with intelligent planning, we bought an 11-stage machine and things got back to normal again.

In our case, generating power pays us dividends. We are a plant operating 24 hr per day, 5 days a week and using the turbine exhaust for heating and processing. We generate 1000-kw per hr at 480-v. Our boiler generates steam at 11 lb of steam per pound of fuel. As for by-product electricity, our cost per kw is 9 mills. The 9 mills represents the cost of operation and maintenance of the turbines. In our case, the turbines act as reducing valves for the process steam.

If C. F. M. can induce the management in his plant to get a good consulting engineer to make a survey of their steam and power requirements and are willing to get the type of turbines that he would recommend, I am sure he will be able to generate his own power at a saving to the company.

C. F. M. must bear in mind that this steam does cost 21.9 cents per 100 lb and it is used only as heat. Why not make the steam more useful by rotating turbine blades before it goes into the heating coils?
JOHN F. SLAVINSKY
Rochelle Park, N. J.

Answer No. 298

What Types of Boilers and Stokers Should They Choose?

Pointers on Boiler Selection

AFTER 21 years of experience with boilers, etc., I would like to pass on some ideas on the type of equipment I would like to have if I were in O. B.'s position. Whether he will be able to get it will be another problem.

In the first place an HRT boiler for that type of load as large as 500 bhp is out of question. The stoker will have to be of a type suited to the kind of fuel he uses or has available for the location his plant is situated in.

As for the boiler, I would recommend two kinds, both of the water tube variety. He could nicely use a box header type of boiler, or he could use a three-drum, bent-tube boiler.

If O. B. used hard or anthracite coal then the best stoker for that kind of service would be a chain grate stoker. I understand this stoker is also widely used in the Middle West for burning coal such as O. B. mentions.

Then there is the spreader type, often with traveling grate, which I am told has been used with much success for burning Mid-Western coals (as well as many other types of coal).

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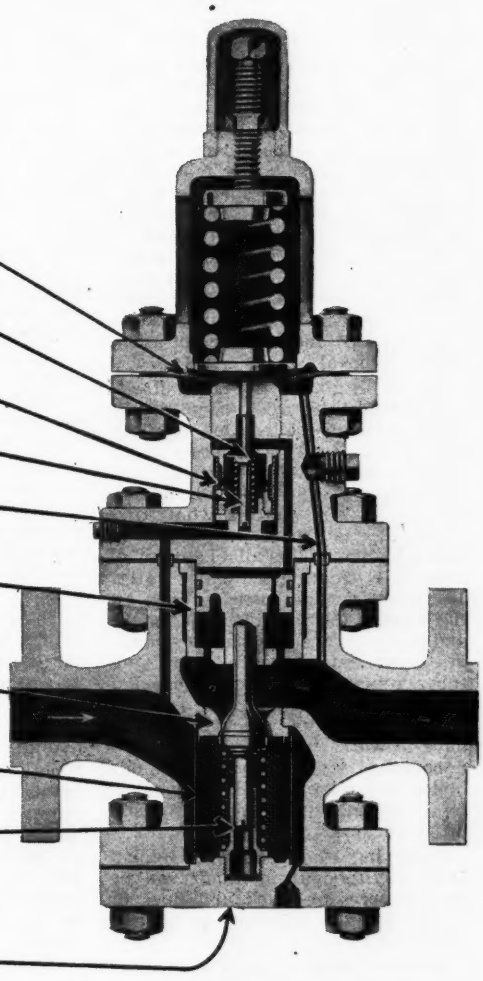
Saves Maintenance Time

for example:

1. Diaphragm unit can be removed without disturbing rest of valve
2. Auxiliary valve is small—easily ground
3. Entire auxiliary valve unit protected by strainer
4. Auxiliary units interchangeable for all sizes from ½" to 4"; 4½" to 10"
5. All ports internal—protected against damage
6. Cylinder liner replaceable
7. Main valve seat ring replaceable
8. Main valve protected by strainer
9. Lower guide bushing replaceable
10. Major overhaul, when necessary, without breaking the line



Foster Type G2S Pilot Operated Reducing Valve for Steam Service

Foster Regulation Engineering, built into each valve, is your assurance of years of accurate trouble free operation.

★ BUY MORE BONDS ★

FOSTER ENGINEERING Company

PRESSURE REGULATORS...RELIEF AND BACK PRESSURE VALVES...AUTOMATIC STOP AND CHECK VALVES...ALTITUDE VALVES...DAMPER REGULATORS...FAN ENGINE REGULATORS...PUMP GOVERNORS...TEMPERATURE REGULATORS...LIQUID LEVEL CONTROLLERS...FLOAT AND LEVER BALANCED VALVES...NON-RETURN AND TRIPLE DUTY VALVES...VACUUM REGULATORS OR BREAKERS...SIGHT FLOW BOXES...STRAINERS...SAFETY VALVES...SIRENS

111 MONROE STREET • NEWARK 1, N. J.

10-PE-1

From my experience with chain grate stokers the maintenance costs are very low, other than replacing a few burnt-out grate fingers which cost about 8 cents apiece. They can be replaced while the stoker is in motion. The transmission gears on the stoker drive last indefinitely if proper lubrication is maintained.

We used cylinder oil for that kind of gear lubrication. In fact, we had used the chain grate stoker from 1924 to 1940 without any excessive maintenance other than replacing one set of chain runners, and an occasional burnt-out grate finger.

With a good balanced draft regulator, they are easy to operate and most any man after some instruction can operate them. With stokers of this type it may be necessary to have forced draft fans. A nice feature of a chain grate stoker, the fire is always self-cleaning. In other words, the coal when it reaches the end of chain grate stoker is reduced to ash which drops to the ash pits. In most stoker installations, a water spray must be used in the ash pits to keep down the dust and cool the hot ashes before removal.

But all in all, for the boiler itself, I would like to recommend the 3-drum, bent-tube boiler. One nice feature of this type of boiler is rapid circulation and fast steaming. Another thing I would like to pass on to O.B. that no matter what kind of boiler and stoker he decides to select he should install a system of chemically treating the boiler water. There are several good systems on the market today that are foolproof and it pays in the long run in savings in boiler maintenance, turbining tubes, replacing burnt out tubes and scaling of the drums. Those jobs are no fun, no matter which boiler you have to work on. Since we installed a chemical treating system on our boiler water, we don't know what it is to turbine tubes and chip scale off the drums.

In buying a new boiler O. B. must bear one thought in mind: can he use the present stack and flues or would he have to install an induced draft fan?

Another thing he may give some thought to is an economizer. In my judgment I believe he could make an economizer pay for itself in about 4 or 5 years.

For every 11 F temperature added to the feedwater from the flue gases with an economizer he will get a 1 per cent fuel saving. With the economizer on our installation we pick up about 56 F in the feedwater which gives us about 5 per cent saving in our fuel costs.

Another thought I would like to pass on to O. B. and that is if you do get a new boiler make sure the boiler is designed to give you a little more steam than you now need. O. B. would be surprised how a little extra boiler horsepower comes in handy sometime when in a pinch. Also the old bhp has a way of sneaking up on you until the first thing you know you haven't enough.

JOHN F. SLAVINSKY

Rochelle Park, N. J.

Answer No. 299

What Sucks the Water Out of the Bucket?

Rate of Ammonia Absorption Causes It

WHEN TRYING to purge when there is nothing to be purged, ammonia enters the purge hose and gets absorbed by the water. The colder the water, and the larger the surface of it exposed to the ammonia, the faster will absorption take place. As soon as the rate of absorption exceeds that of the release of gas through the purge valve, a vacuum is created which causes the atmospheric pressure to push water up into the hose.

New York, N. Y. SIEGFRIED RUPPRIGHT

Flow of Gas and Liquid Might Explain It

THIS QUESTION reminded me of an experience while employed as a member of the erecting crew on the construction of a power plant which included two ammonia compressors.

These two machines were erected and ready for service well in advance of the time when they were needed, so for a time they were only operated for a brief period at intervals to maintain them in good condition.

There were two cylindrical ammonia tanks on the north wall of the building, while the condenser was located on an elevated platform on the opposite side of the same wall.

While the compressors were idle, I noticed that the level of the ammonia in the gage glasses of the storage tanks would gradually go down to a certain level. Then, after an interval, it would rise very rapidly to its highest level, accompanied by the noise of running liquid in the pipe leading from the condenser.

After trying to figure out what was going on, I asked the erecting engineer in charge of the refrigeration machinery, to whom it was an old story, to help me.

Summed up, the process was as follows: The ammonia tanks were in a warm engine room. The condensers, at a higher level, had been carefully located to be constantly exposed to a cold wind blowing in from the Pacific Ocean. The ammonia in the tanks would absorb heat from the warm air in the engine room, and give off gas which filled the condenser pipes until the saturation pressure was reached.

In the cold pipes of the condenser, the reverse process would take place, and the liquefied ammonia would flow back by gravity to the storage tanks completing the cycle.

Now, if J. K. R. tries to purge gas from the condenser while it is full of gas under pressure, it naturally follows that he will have a flow of gas from the purge valve. On the other hand, if he selects the point in the cycle where the condensed liquid is flowing back to the storage tanks, there will be a partial vacuum in the condenser that will suck the water out of the bucket.

HOWARD T. LIVINGSTON

Los Angeles, Calif.

System Pumped Back Too Low

To J. K. R.: When you purge your evaporative condenser, you say you run a hose from your purge valve into a bucket of water and it usually is purged all right. This is the way it should happen; it seems to me that you are doing the purging properly.

But you say that at times the water will be sucked from the bucket.

The reason for this is that there is a vacuum in the system and is generally caused when the system is pumped back and a vacuum is created by pumping back too low. It would be better to pump between 0 and 5 lb pressure, because rarely is there an ammonia plant so tight that air won't be sucked in through the fittings somewhere in the system. That is why it's best not to pump down to a vacuum unless repairs in the system might be necessary. Also never purge or try to purge the system while it is in operation.

Philadelphia, Pa. WILLIAM T. MULLEN

Answer No. 304

How About a Corliss with Three Eccentrics?

ONE of E. C's men, during a 2d class engineers' license examination, was asked what he could tell about a single Corliss engine with three eccentrics. He asked for comments from Q. & A. readers.

Well, there is such an engine and Fred Gould tells how it operates.

How a Corliss with Three Eccentrics Operates

THE CORLISS engine referred to by E. C. was a Nordberg long-range cut-off engine.

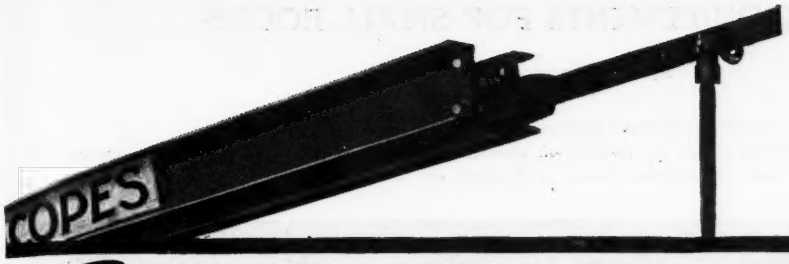
In this engine, one eccentric drives the exhaust valves in the usual manner. The steam valves are also driven by one eccentric.

The third eccentric is used to drive the knock-off cams, with the governor controlling the point in the stroke at which the steam valves are released and allowed to close.

This engine has a range of cut-off, under control of the governor, up to ⅞ stroke.

FRED E. GOULD

West Cummington, Mass.



For SAFETY specify COPES

YOUR BOILER WATER LEVEL will be held well within predetermined safe limits, if you specify COPES Flowmatic for your boiler feed control. A two-element regulator, it has one control element responsive to load changes; the second to level variations. Influence of these elements is quickly, easily adjusted for exactly the water level characteristic you desire - - whether on base or fluctuating loads, and under emergency conditions. No other multiple-element feed water control is as simple, as rugged, as utterly dependable.

Performance is proved daily on more than 1300 modern boilers at pressures up to 1825 psi, with capacities up to 650,000 lbs. per hour. *For complete information, write - - your letterhead, please - - - for Bulletin 429-A.*

NORTHERN EQUIPMENT COMPANY

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REPRESENTATIVES EVERYWHERE

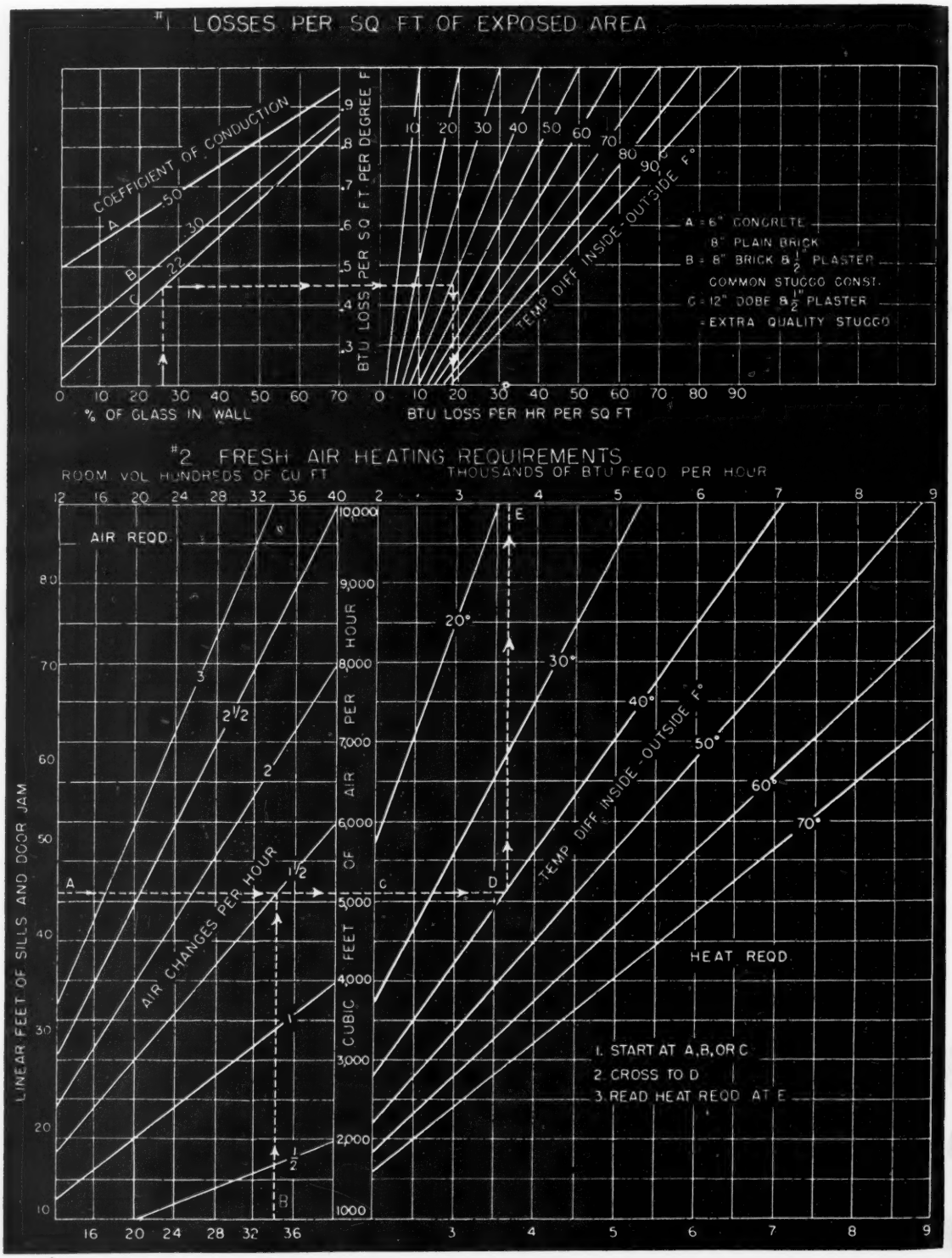
COPES FEEDS BOILER ACCORDING TO STEAM FLOW-AUTOMATICALLY

★ GET CLOSER LEVEL CONTROL WITH THE FLOWMATIC ★ REGULATOR

HEATING REQUIREMENTS FOR SMALL ROOMS

By Bill Maddock

No. 1 gives heat loss through the exposed walls with glass area up to 70% of total wall
No. 2 gives the heat requirements from 3 starting points: A—assumes air leakage from sills and jambs. B—assumes air changes per hour. C—assumes actual cu ft of air per hr



SOLNUS OILS...

end carbon trouble, cut diesel shutdowns in half

An ice and cold storage plant in central Pennsylvania was all heated up about diesel oils. They had two diesels, both direct-connected to ammonia-compressors, and both driving generators by belt drive.

Heavy carbon deposits were sticking the rings and blocking exhaust ports and pipes. Twice a year the diesels had to shut down to have carbon scraped.

Three and a half years ago, a Sun Diesel engineer recommended the proper grade of Sun's Solnus oil for these engines. Since then rings, ports and pipes have been clean. Engines are shut down only once a year, and oil remains clear.

This is just one of the many current cases on file at Sun, which illustrate how the combination of Sun's engineering experience, plus Sun's proved line of diesel lubricants have saved money and eliminated headaches for operators.

Whatever equipment you operate . . . whether diesels, gas engines, gasoline engines, steam engines, turbines or electric motors . . . Sun's industrial products and "know-how" can help you.

SUN OIL COMPANY · ***Philadelphia 3, Pa.***

Sponsors of the Sunoco News Voice of the Air — Lowell Thomas

SUNOCO

SUN INDUSTRIAL PRODUCTS

OILS FOR AMERICAN INDUSTRY

Industry to the Colleges

(Continued from page 65)

this profession than in engineering. It is nonetheless essential to the successful training of outstanding engineers.

Stimulating Ingenuity. A second equally important consideration which must be borne in mind in discussing college curricula is the stimulation of the native ingenuity of undergraduates. During the war period, students have not usually been encouraged to think for themselves in the rush of absorbing detailed knowledge in a rather limited field. We believe that emphasis on engineering fundamentals and ingenuity go hand in hand to develop a successful engineer. To encourage the ingenious student further, the curricula of the future should provide opportunity for the design and construction of ingenious electrical and mechanical devices.

The educational purpose will be better satisfied and more such projects can be provided by the colleges if such devices are small and simple rather than large and complex. At least one college in the Southwest has scheduled this type of a design class with the additional condition that only students who have demonstrated a certain minimum of ingenuity and who strongly desire to take such a class will be enrolled. We believe that the plans for classes such as that suggested will stimulate interest in design and development to an unusual degree.

Extent of Electronics. The need for technically trained personnel acquainted with electronics principles has resulted in the inclusion in most engineering curricula of a number of courses specifically designed to answer such a need.

Although training in electronics during the prewar years was probably inadequate to meet industrial demands, this recent emphasis on education in electronics exaggerates the relative importance of this phase of the electrical industry in the postwar period. In the author's company, for example, estimates of postwar business indicate that the apparatus lines will still be ten times greater than the communications business.

In general, it is preferable to give the student engineer a broad concept of the complete frequeney spectrum, emphasizing particularly the fundamentals underlying the operation of devices at any frequency. Thus, whenever need arises for a fundamental understanding of high-frequency problems, the basic principles are already well understood.

Preparation for Citizenship. There is no doubt that recognition of the more cultural and liberal phases of education has been too long ignored in engineering colleges. Here also, however, there is some reason to advocate caution in the extent to which the nontechnical part is increased. Sir Richard Livingstone is particularly emphatic concerning the periods in a person's life when such material can be most usefully absorbed:

"That is, you cannot study fruitfully liberal subjects, among them philosophy and politics, unless you know something of life. On the other hand, there are subjects, such as mathematics, which a boy or undergraduate is fully capable of understanding, even if he knows nothing outside the walls of his home, school, or university. For whereas politics and ethics are concrete, mathematics is purely abstract and theoretic and does not spring from life or need experience of life to illuminate or correct it."

We believe that the principal purpose of such subjects as English, public speaking, and art of dealing with others, in engineering curricula, should be to acquaint the undergraduate with the importance of these subjects and to develop his appreciation for them as essential to his future career even as an engineer. All of these liberal subjects should be taught by a person who has a sincere appreciation for the role of the engineer in society and who can fully understand the engineering point of view. It is only such leadership that can stimulate and impress the young engineering student with the importance and value of such liberal material.

We would also suggest that in spite of the modern tendency to depreciate the value of foreign languages in the curricula, there is a real value in the study and mastery of languages other than our own. The study of history, economics, and civics should not be neglected, but in these also emphasis should be placed upon developing an attitude of mind in the student which will make him aware of the engineer's responsibility as a member of society and the large part which he should play in such society.

Adult Education for Engineering Graduates

Recognition of the importance of adult education has increased greatly in the past few years. There has been a strong tendency for the college graduate to consider his education completed.

The proper attitude toward education as a process of continual growth should be stressed again and again to the undergraduate. He will then recognize that without education there can be no growth, and without growth of individuals there can be no progress.

What Has Been Done. In Denmark, "high schools" have been established to provide liberal education for adults. What has been accomplished in this field in this instance is strikingly described by Sir Richard Livingstone in these words:

". . . the Danish People's High School, should be of peculiar interest to us for it is the only great successful experiment in educating the masses of a nation. It has reached the very classes for which we have done little or nothing. It has taught them to care for subjects like history and literature which seem remote from the man in the street. It has transformed the country economically, given it a spiritual unity, and produced perhaps the only educated democracy in the world. . ."

A New Area of Engineering Education. We believe that the colleges and universities of the country should take the lead in providing adequate opportunities for education in liberal subjects for engineering graduates. In many cases this may involve considerable rearrangement of schedules and programs to accommodate evening classes. The value to the nation and to the individual adult student far outweighs the difficulties which must be overcome to provide such opportunities.

The Most Important Factor in Education

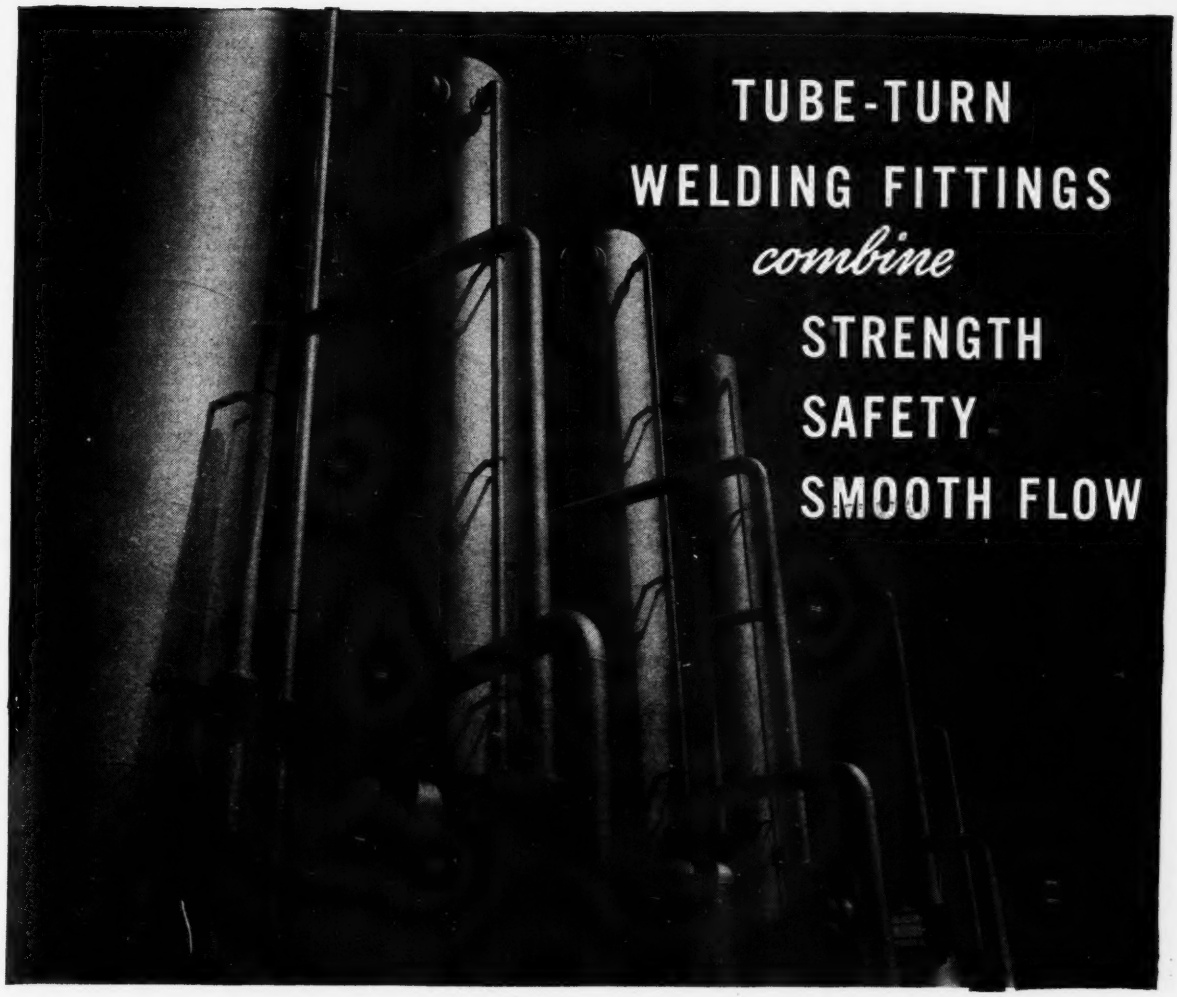
Although revision of engineering curricula is a laudable undertaking, it is almost useless to consider such changes apart from the teaching staff. The failure to stress the significance of outstanding teachers in college education is to neglect the most important factor in education.

The Contribution of a Great Teacher. Wherever there are great men, there is so often a great teacher behind them. There is nothing more important than teaching. There are many outstanding teachers in the colleges now; their numbers must be increased. We must have the best and most capable men in the nation guiding the education of youth.

Leadership—A Pressing Need

In our desire to improve the average intelligence, we have more and more neglected the brilliant individuals. We must recognize that the contributions to society of an Edison, Marconi, or Alexanderson are far greater than those of scores of John Does. Without depreciating the necessity for mass education, we must in the future concentrate on developing an equally good system for educating the outstanding individuals.

We have great interest in the proposal that undergraduate leaders be selected to assist the regular professors. These carefully selected young leaders, if given proper freedom, could do a much better job of stimulating the students than some of the present instructors who remain on the college pay rolls without promotion for several years. The average pupil would thus simply go through the classes in the present manner, the outstanding student would get the extra opportunity, responsibility, and incentive of teaching a younger class.



PHOTOGRAPHED in Louisiana, this is a section of the world's largest field stabilization, gasoline recovery and pressure maintenance plant. Such an investment calls for the utmost in engineering for trouble-free performance. Tube-Turn welding fittings were specified.

Among the reasons governing this choice in fittings were the extra strength resulting from Tube Turns' exclusive manufacturing methods, the safety insured by this strength, and the efficient flow made possible by smooth, obstruction-free inner surfaces. The considerable saving in weight over other type fittings is also an important factor in this type of construction.

For complete information on the superiority of Tube Turns' exclusive manufacturing methods and data on successful installations in many industries, write for latest complete Catalog 111.

Selected Tube Turns Distributors in every principal city are ready to serve you from their complete stocks.

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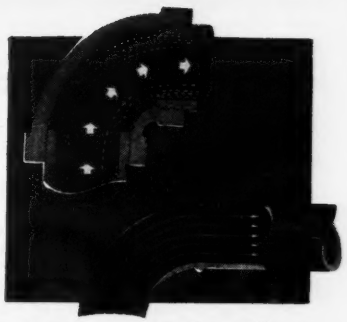


Compare for Smoothness

See how sharp corners and surface irregularities obstruct flow in cast iron threaded elbow. Compare for smoothness with unobstructed flow in smooth Tube-Turn elbow.

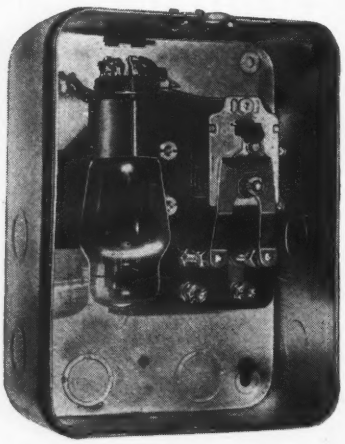
TUBE-TURN TRADE MARK *Welding Fittings and Flanges*

NEW EQUIPMENT

Information that you desire about any equipment will be gladly furnished without obligation. Write to POWER PLANT ENGINEERING 53 W. Jackson Blvd., Chicago 4, Ill.

Electronic Relay

THE SUPER SENSITIVE ELECTRONIC RELAY, manufactured by Precision Thermometer & Instrument Co., 1434 Brandywine St., Philadelphia, Pa., is a grid controlled, half-wave rectifier that combines in one compact unit all the functions of a series of relays such as are commonly employed for control of outputs up to 30 amp. 110 to 120 v, 50-60 cycle, a-c up to 30 amp are controlled with only 100 microamperes in the instrument circuit.



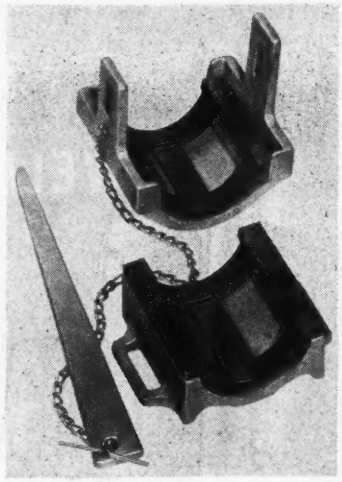
Originally developed for use with "Princo" mercurial thermostats and thermoregulators, these relays are used in a wide variety of industrial and laboratory control applications with such instruments as contact microammeters, pressurestats, photoelectric cells and similar apparatus.

Flexible Pipe Couplings

DRINKWATER, INC., 2323 South Michigan Avenue, Chicago 16, Ill., has developed a new line of flexible pipe couplings known as Drinkwater Presto-Lock Couplings which are made in 11 sizes from 1¼ in. to 16 in.

An important feature of these couplings is that they can be used with any plain end pipe without threads, grooves or flanges. No wrenches or special tools of any kind are required in assembly. Only a hammer is needed to tighten wedge keys after the two sections are fitted over pipe ends and wedge keys have been inserted in the key channels.

The three parts of the couplings are the two corrosion-resistant malleable iron castings and the quick-locking wedge key. Small sizes are equipped with one wedge key and chain assembly to prevent loss of coupling parts. Large sizes have two wedge keys but no chain assembly. The gaskets which are used have been specially designed to effect a permanently tight seal on all types



of pipe lines. Three types of gaskets are available, these being synthetic rubber, neoprene and natural rubber.

Tests by the manufacturer show that these pipe couplings give up to 40 deg flexibility at each joint. In other words, it acts as a sleeve, elbow and ball union at all times. They can be used for repairing any size leak that the coupling will cover and they withstand all normal working pressure of gas, steam, oil and water.

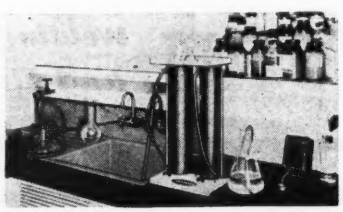
De-Ionized Water from Lab Units

DEVELOPMENT OF compact laboratory units for producing purified water said to be comparable to distilled water has been announced by the Illinois Water Treatment Co., Rockford, Ill.

The portable 12-gallons-per-hour unit, embodying the de-ionizing principle, weighs only 35 lb; is 22 in. high, 13 in. wide, 8 in. deep. Larger laboratory units, providing 60 gph and 100 gph, are approximately 60 in. high, 30 in. wide, and 20 in. deep.

Economy of operation is a dominant factor. Periodic dismantling for cleaning is not required, and the quality of the water is protected throughout the equipment by Saran plastic and hard rubber. Water remains under pressure to the point of use. No cooling water is required, no heat or fuel.

In the de-ionizing process the raw water passes through two beds of special synthetic resins, the first of which removes the positive ions, such as calcium, magnesium, sodium, iron, etc., and substitutes hydrogen. The hydrogen combines with the negative sulfate, chloride and nitrate etc. ions, to form the equivalent acids.



This acidic water passes to a second tank where the acids are removed by absorption.

Diesel Fuel Oil Improved

COMBUSTION CHARACTERISTICS of Diesel fuels can be improved, it is claimed, by the use of a new material developed by Industrial Chemical Co., 628-630 West 9th Street, Los Angeles 15, Calif., and marketed under the name "Induco Fluid."

When added to Diesel fuel oil, this fluid chemically converts sludge, gums and resins into usable hydrocarbon compounds. The undesirable materials are placed into suspension in the fuel oil and consumed in combustion as usable Btu's, increasing combustion efficiency and raising the power output of the engine. By the removal of sludge and lamp black from the fuel oil, smoking and the formation of hard carbon is eliminated.

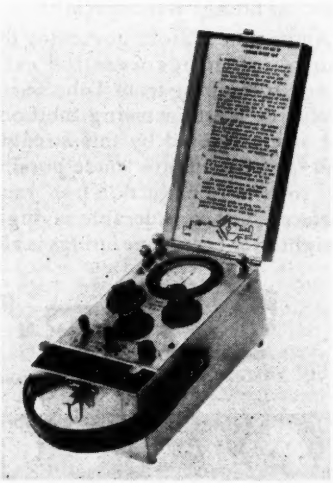
Use of the fluid overcomes the clogging injectors and the formation of hard carbon deposits in cylinders. The cost of fuel oil is increased only five mills per gallon, which is saved in reduced fuel consumption, with substantial economies resulting from decreased maintenance and repair to engines by carbon elimination.

Lineman's Bridge

SMALL, RUGGED and compact enough to be carried easily, this bridge, developed by Nilson Electrical Laboratory, Inc., 103 Lafayette St., New York 13, N. Y., measures 9 by 5 by 4½ in. and weighs only 5 lb complete. It is built to meet the requirements of the telephone and telegraph lineman.

The instrument is used to measure the resistance of wires as well as the unbalance between two wires. The design is such that the reading on the loop can be changed to the unbalance reading without disturbing the connections. This is done in a few seconds by throwing a switch and changing the position of the three decade dials.

The switching arrangement also designates which wire is of the higher resistance. The range of meas-



An outstanding performer, viewed from every angle

This new engine, direct connected to a 500 kw. generator, will be used for auxiliary power in a Navy AR repair ship. Just one of many responsible jobs where the ability to deliver dependable power under severe service conditions is a Number One requirement.

In all types of service, the sound engineering and sturdy qualities of Baldwin Diesels are reflected in high efficiency, maximum availability, and minimum repairs. When you need a Diesel, check the Baldwin line; there's a type and size for almost every need.

The Baldwin Locomotive Works, Locomotive and Ordnance Division, Philadelphia 42, Pa. Offices: Philadelphia, Chicago, St. Louis, Washington, New York, Boston, San Francisco, Houston, Cleveland, Detroit, Pittsburgh.

BALDWIN PRODUCTS

Locomotives, Hydraulic presses, Testing equipment, Steel forgings and castings, Diesel engines, Metal plate fabrication, Rolled steel rings, Bronze castings, Ship propellers, Marine steering gear, Heavy machine work, Crane wheels, Bending rolls, Plate planers, Babbitt metal, Alloy iron castings, Briquetting presses.

THE BALDWIN GROUP

BALDWIN

DIESEL ENGINES

urement is up to 111 ohms in steps of one-tenth of an ohm with an accuracy of one-quarter of one per cent. The galvanometer which is a Weston Model 375 has a sensitivity of approximately 22 microamperes per division for 30 divisions, and is an extremely hardy instrument. Batteries are standard 1½ volt flashlight cells that are so arranged that they can be quickly and conveniently replaced.

It can also be used as a general-purpose bridge up to the limit of its capacity.

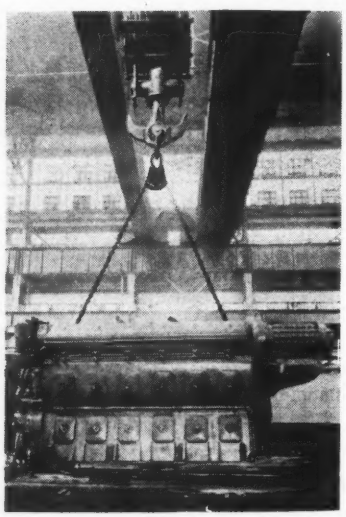
Propeller-Type Meter

WIDELY USED FOR metering water at ordinary temperatures, Builders Propeloflo Meter, made by Builders-Providence, Inc., (Division of Builders Iron Foundry) Providence 1, R. I., is now available for metering hot water up to 250 F. A special high temperature grease is employed for lubrication. Venturi design and all other special features of this streamline propeller-type meter are retained. The Propeloflo is useful where a simple totalizing meter is desired.

Self-Leveling Slings

HERCULES SLING CO., Rockford, Ill., has introduced a complete line of Safe-T-Lift automatically equalizing chain slings made in 4 ton, 7 ton, 14 ton, 25 ton and 40 ton capacities.

In operation, the block or chain equalizer unit is placed on the crane hook and the crane operator spots the hook over the approximate center of gravity of the load. Floormen then attach the sling's chain legs to the load.



Power to lift the load is applied by the crane operator, and as the crane hook rises the sling's chain automatically adjusts itself through the equalizing unit. The unit consists of a steel block and a floating sheave specially constructed to fit the steel alloy chain.

When loads are lifted, one chain leg becomes longer than the other and as the weight of the load pulls on the chain, the sheave in the equalizing unit pulls down against a brake, preventing slippage. Perfectly level lifting of the load is assured.

Tube Cleaning Tool

SPARTAN TOOL CO., 6007 Lincoln Ave., Chicago, Ill., announces the introduction of a self-contained power-driven tool for cutting and removing obstructions, stoppages, slush or scale from curved or fitted pipes, drains, tubing, sewer lines, steam risers, humidifiers, etc.

The machine is designed to house and drive ½ in. by 100 ft of flexible steel shafting. The flexible rod automatically coils and uncoils as it is fed into and from the container. The

driving mechanism is a motor-driven head which is removable from the stand. In operation, this driving unit is held at the opening of the pipe or tube so that the desired length of flexible rod may be fed into the pipe.

For removing waste material or scale the flexible rod is equipped with elyptical shaped, spring steel, cutter heads as is shown in the illustration. The normal speed of these cutter heads is 300 rpm.

Electronic Feeder Control

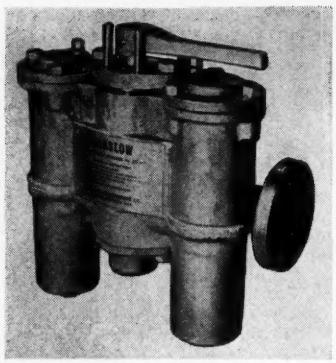
HAMMER MILLS, attrition mills, and cutters may now be controlled by a new electronic feed regulator developed by Mosher Electronic Controls, 130 West 42nd Street, New York 18, New York. The electronic regulator maintains the load on pulverizing equipment at the maximum rated capacity of the connected motor. Thus production is kept at peak continuously.

Momentary overloads are prevented from actuating or disturbing the feed control relay. An underload light signal indicates failure of material to reach pulverizer due to empty bins or arching at some point in the flow above the feeder. Additional light or sound signals can be wired to any required location.

Duplex Magnetic Strainer

COMBINING THE effect of powerful permanent magnets with fine screening to remove filings and metal particles from oil systems or other liquids, the Winslow Engineering Co. of Oakland, Calif., has recently developed an improved magnetic strainer which incorporates a number of distinctive features. The basic design is applicable to a great variety of liquid filtration problems.

Two cylindrical baskets consist of a main body of perforated steel, within which are fine wire mesh linings.



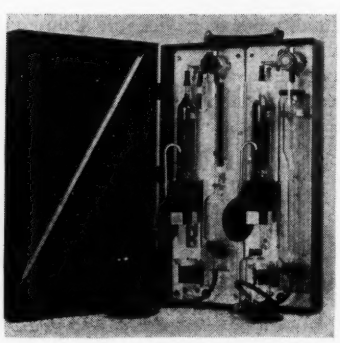
The magnets are suspended within these baskets. Of either cast bronze or iron, the one-piece body incorporates the manifold, strainers, inlet and outlet connections, by-pass valves, pressure regulator, and main control valve. The quick-acting hand-operated three-way control valve, simplified so as to require no jacks to lock it in place, permits change of flow from one strainer element to the other, or through both simultaneously. A safety factor is the fact that flow is maintained through either one or both strainers regardless of the position of the valve control lever. With flow directed through one basket, the other basket and magnet assembly can be removed for cleaning as one unit. If necessary, the magnet assembly can easily be detached from the basket for additional cleaning or inspection. Out-going pressure may be regulated by a valve adjacent to the three-way valve.

Developed originally for use on steam turbine power plants, the Model 200-MS-1 Winslow Duplex Strainer handles 15 gpm. Also available is a larger model handling 40 gpm.

Gas Analyzer

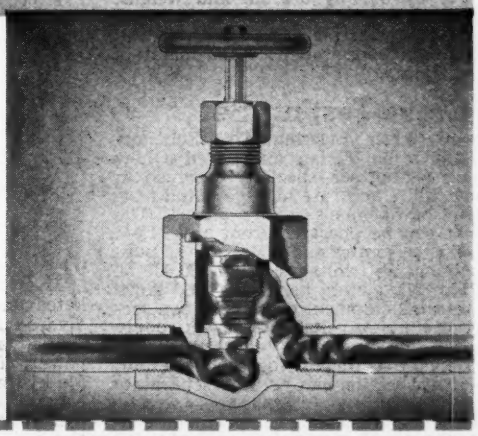
THE HAYS CORP., Michigan City, Ind., announces the development of a special analyzer for testing the high purity of oxygen, carbon dioxide, and nitrogen in the range from 90 to 100 per cent.

It is of particular interest to the manufacturers of commercial oxygen and carbon dioxide but has many practical uses also in industrial processes. The new analyzer known as the Hays Series "E" came into being as the result of the demand for testing the high purity of oxygen for use in flying. It is quite similar to the standard orsat but its technique in operation differs somewhat.



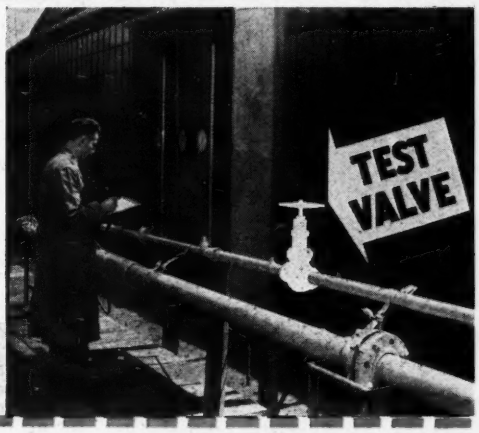
HOW EDWARD VALVES CUT PRESSURE LOSS, PREVENT UNDUE TURBULENCE and SAVE MONEY

PROBLEM: In an ordinary globe valve, sharp turns often cause excessive turbulence and increase pressure drop. Valve wear is accelerated, power is wasted and efficiency lowered. Years ago, Edward began research on the problem of reducing pressure drop through small forged steel valves.



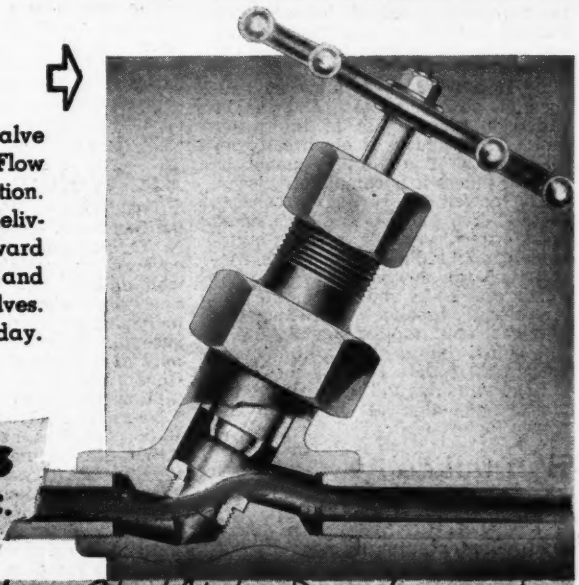
Here's what happens to flow in an ordinary globe valve. Sudden changes in direction mean excessive turbulence and increased pressure drop. Flow like this is a fuel thief—a money waster!

SOLUTION: Long ago, Edward designed the 60° stem globe valve as the first big step. For the past several years, Edward engineers have conducted a continuing and integrated program on flow characteristics and pressure drop. Actual flow tests on Edward and other valves guided the new design improvements now standard in Edward inclined-stem forged steel globe valve construction.



Special test hook-up for measuring pressure drop and determining flow principles through valves. Orifice type flow meters, mercury manometers and gages are used to check actual pressure loss.

RESULT: This is the flow pattern through today's streamlined Edward inclined-stem valves with globe valve tightness and gate flow. Flow is eased through with no sharp changes of direction. With these Edward valves, maximum volume is delivered at the equipment where it's needed. Edward BETTER VALVES Catalog No. 103 gives dimensions and design data on these and other Edward steel valves. If there isn't a copy in your file, write for one today.



EDWARD *Steel* VALVES
THE EDWARD VALVE & MFG. CO., INC.
EAST CHICAGO, INDIANA

*Look to Edward for the **Best** in New Steel Valve Developments*

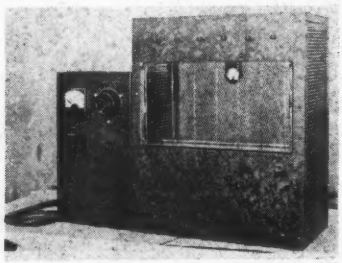
Two styles are available: a wall mounted model for permanent installation and a portable model supplied in a neat metal case with leather carrying handle. It may be had with a single unit or with two units. A junior model (Series EJ) is also obtainable with a burette capacity of 30 cc. The smaller model measures 6¼ by 9⅝ by 3¾ in. and weighs, fully charged, less than 6 lb.

All models feature a new four-way valve to conserve space and facilitate operation.

Glove-Testing Set

GENERAL ELECTRIC Co., Schenectady 5, N. Y., has announced a new a-c testing set, specially designed to facilitate accurate high-potential testing of linemen's rubber gloves. The set can be operated from any 115-v, 60 cycle outlet and is capable of supplying test voltages up to 20,000 v. This completely metal-enclosed glove testing equipment consists of two sections, a high-voltage a-c power supply and a glove-testing cabinet, so designed that they fit together as a unit. Either section can be used separately if desired.

The glove-testing compartment contains a water tank in the lower section, provided with supports for simultaneous testing of six standard linemen's rubber gloves. Contact with water inside the gloves is made by chains hanging from a high-voltage bus which is solidly supported on in-

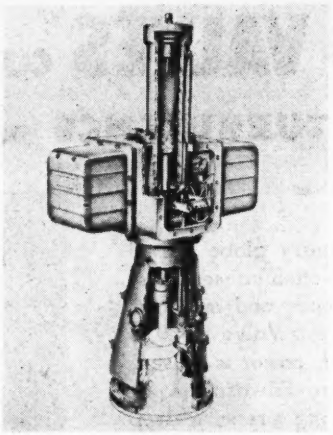


sulators. A milliameter connected in the high-voltage circuit indicates the leakage current in any glove if any one of the six control buttons at the top of the cabinet is pushed. A large plate-glass window permits visual inspection during the test, and can be raised to give access to the water tank. The window is electrically interlocked so that voltage cannot be applied unless it is completely closed.

The power supply section consists of a 2-kva, 20,000-v oil-immersed transformer, variable voltage autotransformer for smooth voltage control, a large switchboard-type voltmeter with 10-kv and 20-kv scales, an air circuit breaker with magnetic overload trip, supply switch, and a red signal lamp. The voltmeter is energized from a coil in the high-voltage winding, and gives highly accurate indication at all loads and power factor.

Hydraulically Operated Valve

INTRODUCTION OF hydraulically operated valve actuator to cover a wide range of sizes and applications has been announced by Pacific Division, Bendix Aviation Corp., North Hollywood 27, Calif.



This actuator, which is being marketed under the name of the Bendix Hydrodyne Actuator, combines all the advantages of direct hydraulic power. The unit incorporates a simple hydraulic system which produces force in a straight line through a hydraulic cylinder to open and close the valve. As the valve seats the hydraulic pressure continues to build up, literally pressure-sealing the gate against leakage. Pressure is then hydraulically locked in the cylinder and only the reverse action will unlock it. Should pressure drop from any cause it is automatically reestablished immediately. In addition, the unit is provided with a completely independent hydraulic system, using a hand pump, for emergency.

This pressure-sealing action entirely eliminates any backlash in the seating operation. Further advantages of the hydraulic operation eliminates the "hammer-blow" action of other actuating devices and reduces maintenance of the entire actuator to routine inspection as the hydraulic oil serves as a lubricant for all moving parts.

The new Bendix Hydrodyne Actuators are available for use on valves from 4 to 36 in. and auxiliary regulating and indicating equipment can be provided for step-by-step position control, infinite position control or on-and-off control for virtually any type of application.

Arc-Welding Electrode

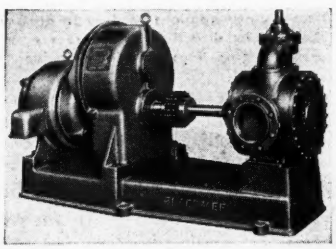
THE ELECTRIC WELDING DIVISION of the General Electric Co., Schenectady, N. Y., has announced a new heavily covered arc-welding electrode for welding low-alloy, high-tensile steels. Specially designed for use on carbon-molybdenum steel in the high-pressure piping industry, this electrode may also be applied to vessels (fittings) and structural weldments of innumerable kinds.

The new electrode, known as Type W-56, operates satisfactorily on either alternating or direct current, reverse polarity, and its range of current is sufficiently broad to cover a wide range of plate thicknesses. A medium-long arc is recommended for best results with this electrode. It can be used in the flat, vertical, and overhead positions. It produces a relatively flat deposit, particularly in the vertical position.

Features of the new electrode include a stable spray-type arc, deep penetration, and excellent creep-resisting qualities. In addition, the covering used produces an easily removed, light friable slag, which sets up fast, thus facilitating proper manipulation of the electrode. The new electrode is available in sizes 1/8, 5/32 and 3/16 in. in diameter.

Rotary Pump for Viscous Liquids

BLACKMER PUMP Co., Grand Rapids, Mich., has recently put into prodution a line of steam-jacketed rotary pumping units of considerably improved design, especially suited for handling sludge and other viscous liquids. The unit has a capacity of 500 gpm at 150 psi pressure and is powered by a 75 hp gearhead motor with a speed of 155 rpm on the drive shaft. The pump construction is iron,

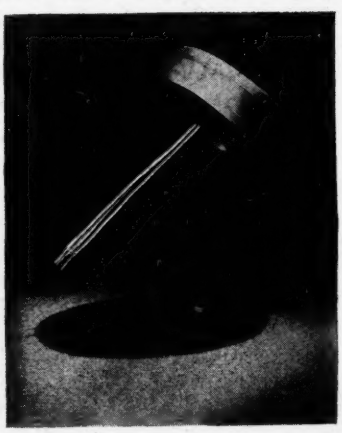


bronze-fitted and the entire unit is mounted on a cast-iron base. The steam jackets are suitable for pressures up to 125 psi and are located on both heads.

Units in capacities of 50, 90 and 200 gpm, with gearhead motor or reduction gear drive are also available with steam-jacketed heads of this construction. All of the new units operate on the bucket design, swinging vane principle, and are self-adjusting for wear.

Ballasts for Circline Lamps

NEW DISK-SHAPED ballasts for the operation of 12-in. Circline fluorescent lamps have been announced by General Electric Co., Schenectady 5, N. Y. Their flat, disk formation, with a center hole for mounting, makes them easily adaptable to assembly



BETTER THAN EVER!

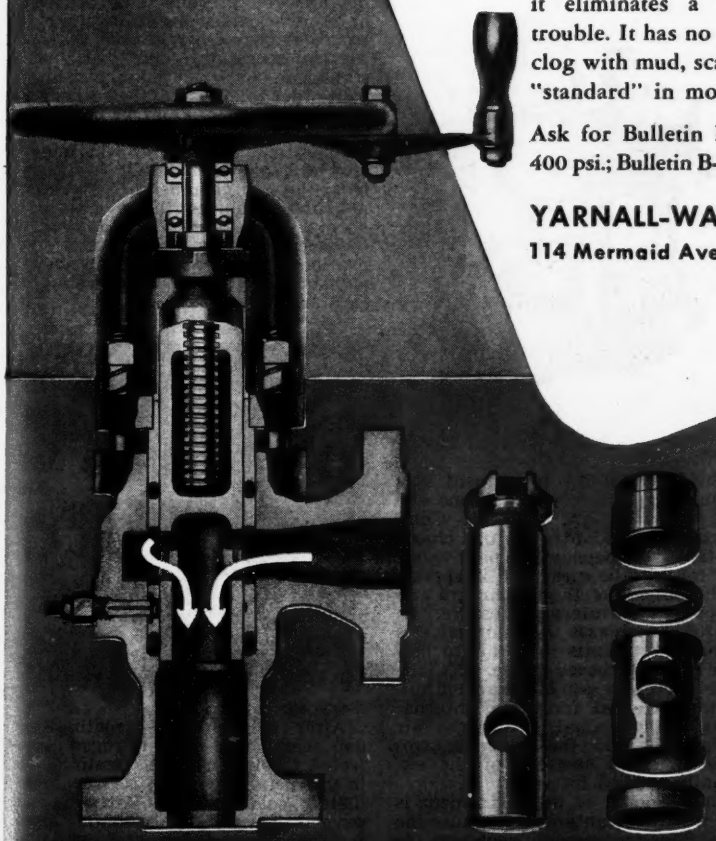
Constant metallurgical and mechanical research—aimed solely at improving boiler blowdown service—have made today's Yarway Seatless Blow-Off Valves literally "better than ever."

From the Yarway Research Laboratory have come such basic improvements as nitrided nitralloy sliding plungers and Neoprene-type packing rings. Both greatly increase the service life of Yarway valves . . . make them even more of a favorite among the nation's power plant operators.

The Yarway Seatless Blow-Off Valve has been hailed since its introduction because it eliminates a source of continuous trouble. It has no seat to score, wear and clog with mud, scale and dirt. Today it is "standard" in more than 12,000 plants.

Ask for Bulletin B-424 for pressures to 400 psi.; Bulletin B-432 for higher pressures.

YARNALL-WARING COMPANY
114 Mermaid Ave., Philadelphia 18, Pa.



SEE YARWAY BLOW-OFF VALVES ...HEAR LOWELL THOMAS describe their design and application in the new 30-minute color and sound motion picture "There Is An Engineering Reason." Free for group showings. Write for details.

YARWAY BLOW-OFF VALVES

on the stem of a portable lamp and to concealment in the lamp base. They are also easily adaptable to shallow-type wall or ceiling fixtures.

These new ballasts are currently available in two single-lamp types, either a conventional, uncorrected power-factor design, or a high power-factor, lead-circuit design without a step-up autotransformer. A compensator is provided in the latter to raise the starting current and it is intended for use only with a manually operated starter.

The leads of both types are brought out through the ballast cover-plate and threaded through the lamp stem for connection to the fluorescent lamps.

New Engine Lubricant

A NEW INTERNAL COMBUSTION ENGINE LUBRICANT, reported to have unusual advantages over mineral oil, particularly for cold weather use, has been announced by Carbide and Carbon Chemicals Corp., a Unit of Union Carbide and Carbon Corp. This lubricant, which is now being produced in commercial quantities, has properties quite different in many respects from oils derived from petroleum.

The lubricant can be manufactured to any desired viscosity and is wax-free. Pour-points vary from — 30 to — 80 F. Flash points range from 300 F. up. The new materials have densities approximating that of water. Carbon residue values are less than 0.01 per cent, regardless of viscosity. The lubricant is characterized by low change of viscosity with change in temperature, having viscosity indices in the range of 140 to 160.

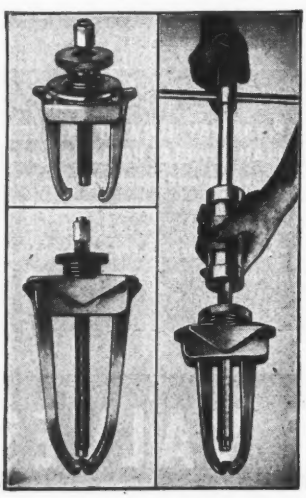
Gear Pullers

PULLING OPERATIONS are facilitated by a series of matched gear pullers which provides the proper tools to cover a wide range of pulling utility, a product of Snap-On Tools Corp., Kenosha, Wis.

The series includes three sizes of standard pullers with maximum jaw capacities of 4½ in., 8½ in., and 14 in. In addition the small and medium sizes are also available in the slide-hammer design or they can be furnished with all parts necessary for use as either standard or booster hammer pullers, providing adaptability of the puller to the characteristics of each pulling job.

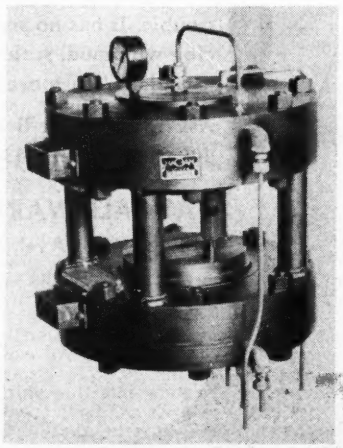
Yoke and jaw construction is identical on all models with a spring controlled jaw lock designed to give a safe, slip-proof, and tip-proof grip on the part to be pulled.

The hexagon end on the standard model pressure screws can be turned with standard wrenches. On the slide hammer type pullers the centralized, guided shock of the booster hammer, combined with the screw tension, provides an exceptionally large pulling force. It distributes the pull equally, and removes the part safely and quickly.



Torque Measuring Instrument

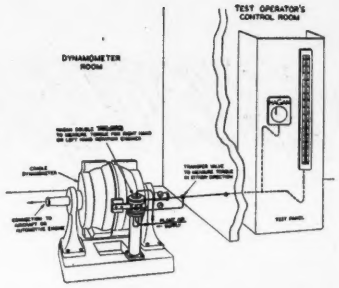
USING AN INSTRUMENT employing air as a medium for accurate measuring and weighing has been accomplished by the Hagan Corp. of Pittsburgh. Because of its extreme sensitivity and the simplicity of both its principle and design, the new instrument, called the Thrustorq, already is being used in engine testing laboratories and factories to determine and record the thrust and torque of conventional airplane and automobile engines.



The heart of the instrument is a flexible diaphragm which forms one face of an airtight chamber. Compressed air is admitted to this chamber through a poppet type pilot valve. The force to be measured is applied to the outside of the diaphragm and is opposed by internal pressure. As the force increases the pilot valve is opened and admits more air to balance the increased force. As the force decreases, air is exhausted until the external force and internal pressure are equal. Thus the air pressure within the chamber provides a direct measure of the externally applied force.

The response of the instrument is practically instantaneous because the diaphragm movement necessary to operate the pilot valve is extremely small.

Because the force is measured by air pressure, the Thrustorq permits remote reading on any number of manometers, pressure gages or recording devices. The new instrument has no intricate mechanisms, knife edges or other parts subject to wear.



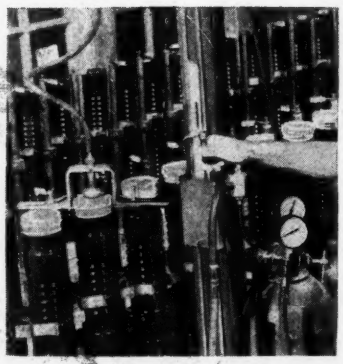
Although the Thrustorq's first application in industry was the obvious one, to measure the thrust and torque of engines, its characteristics have suggested many other uses.

Lightning Arrester

PELLET-TYPE lightning arresters for the protection of apparatus on distribution circuits 15,000-v and below, are now of a new design having a separately sealed, nitrogen-filled gap chamber, according to an announcement by the General Electric's Transformer Division, Pittsfied, Mass.

This development marks the first use of inert gas in arrester gaps. The dry-nitrogen prevents the formation of ozone or oxides, keeps the gap electrodes bright as new during years of service operation, and gives more stable gap-sparkover characteristics.

In order to eliminate the recognized adverse effects of internal condensation caused by changes in outdoor temperature, all air and atmospheric moisture are completely evacuated from the gap chamber. This process not only excludes the moisture of normal atmospheric humidity from the series gaps of the arrester, but provides an error-proof, vacuum-withstand test of the main sealing of each arrester as well.



After completely evacuating the gap chamber, the dry-nitrogen is injected through a small treating hole in the metal cap which is then immediately solder-sealed. Excluding all oxygen, which is the essential agent for ozone and all forms of oxidation, the injected dry-nitrogen is thus permanently sealed in the gap chamber. It assures an initially moisture-free gap chamber which remains moisture-free through years of continuous operation.

URGESS—ORIGINATORS OF SNUBBING PRINCIPLE FOR QUIETING DIESEL EXHAUSTS—BURGESS—ORI

BURGESS SNUBBER BULLETIN for Diesel Exhaust Noise Control

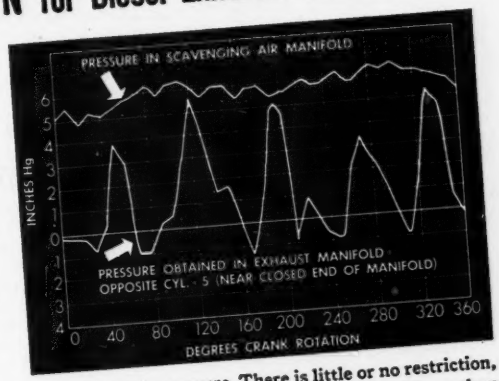
DOES YOUR ENGINE HAVE EXCESSIVE BACK PRESSURE?

High back pressures, as indicated by a U-tube manometer, sometimes cause alarm among operators of 2-cycle engines. But back pressure, which may seem high by this method of measurement, does not always have a bad effect on the operating efficiency of the internal combustion engine.

Back pressure in the exhaust manifold of a 2-cycle engine is harmful only when it interferes with scavenging. Ideal conditions are maintained when instantaneous peak back pressures do not exceed the air intake manifold pressure, and a margin of scavenging air pressure is maintained over the instantaneous exhaust pressure during the scavenging period for each cylinder.

Burgess engineers recently conducted tests on a 2-cycle Diesel engine operating with an excessive back pressure as indicated by a U-tube manometer. The tests were made with the Burgess Sampling Manometer . . . a device which records instantaneous pressures throughout the engine cycle.

A glance at the accompanying pressure curve chart reveals interesting performance data. At no time did the exhaust pressure exceed the intake manifold pressure, even at the peaks. There is no evidence that high exhaust pressure peaks caused any modulation of the scavenging air pressure. There is little or no restriction, because exhaust pressures fall almost as rapidly as they rise. Furthermore, the exhaust pressure falls below atmospheric pressure after each peak, which facilitates normal scavenging of the cylinder.



In addition test records showed that fuel consumption and exhaust temperatures were normal. Silencing from the Burgess Exhaust Snubber was good.

Thus, it can be concluded that excessive back pressures, as measured by a U-tube manometer, do not necessarily indicate undesirable exhaust system conditions, and that the suitableness of any exhaust system can only be determined by further analysis.

* * *

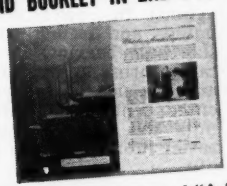
DID YOU EVER SEE THE WORKINGS OF A DIESEL LOCOMOTIVE?

Here is a Diesel locomotive with its hat off!

It is the Milwaukee Road's 120 ton "switcher" developed by Fairbanks Morse & Company. The engine is of the opposed piston type.

A unique feature of this unit is the use of two each, Burgess Exhaust Snubbers and Burgess Air Intake Cleaners. The exhaust Snubbers are located at the head-end and vent to atmosphere through two roof apertures. They effectively dissipate the energy of the exhaust gases and assure quiet locomotive performance.

SOUND BOOKLET IN 2ND PRINTING



The second printing of "A Story of Sound" has been completed.

If you have not received your free copy, we urge you to write for it now. The phenomena of sound and their application in the Diesel engine field is a subject of interest to every Diesel engine man.

BURGESS INDUSTRIAL SPARK ARRESTER-SNUBBER STS SERIES

The Burgess STS Spark Arrester-Snubber removes sparks and solid matter, and prevents exhaust noise.

When the exhaust slug enters the Snubber, a stationary impeller throws out the solid matter and partially breaks up the exhaust slug. The cleaned exhaust gases then enter the snubbing section where the kinetic energy is dissipated, resulting in a quiet exhaust.

Burgess Spark Arrester-Snubbers should be used wherever exhaust sparks create a hazard . . . aboard ship, in logging camps, and around oil refinery equipment.

Published by BURGESS-MANNING COMPANY Chicago 18, Illinois

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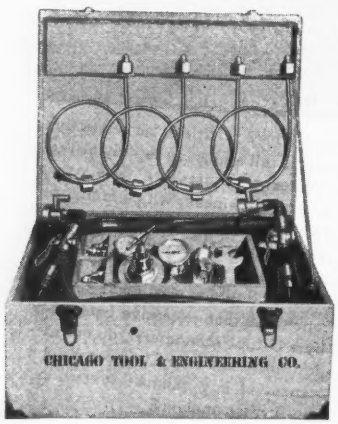
URGESS—ORIGINATORS OF SNUBBING PRINCIPLE FOR QUIETING DIESEL EXHAUSTS—BURGESS—ORI
OR COMPLETE SATISFACTION IN EXHAUST AND INTAKE QUIETING—SPECIFY BURGESS SNUBBERS—FOR

Underwater Arc-Oxygen Equipment

CUTTING OF METALS under water by the arc-oxygen method during the war became a commonly used art and now that the war is over the equipment that was developed for that purpose has been made available for civilian use. The Chicago Tool and Engineering Co., 8383 So. Chicago Ave., Chicago 17, Ill., spent several years in perfecting the equipment necessary for this operation which they are now offering to industry in general.



It is reported that the necessary instructions for operating the arc-oxygen underwater cutting tools are so simple that a diver can learn in a few hours to use the method to approximately the full capacity. In regard to speed, laboratory tests have shown that 1-in. steel plates can be cut at the rate of approximately one foot a minute.

Silicone Varnish

BECAUSE OF ITS low curing temperature (300 F) DC 996 silicone varnish, produced by Dow Corning Corporation, Midland, Mich., enables all types of electrical shops to realize the advantages of silicone insulation. Among those advantages are greater protection against failure due to sustained overloads; greatly increased service life of electrical insulation; higher permissible operating and ambient temperatures; increased protection against excessive moisture even after prolonged exposure to elevated temperatures; the elimination of fire hazards resulting from the failure of conventional electrical insulation; and increased power output per unit weight.

Electrical equipment wound with silicone insulating materials and sealed by impregnating with DC 996 will have the high order of thermal stability and the retention of waterproofness characteristic of silicone insulation. DC 996 can be cured at temperatures obtainable in ovens now used for curing organic varnishes.

Another advantage of this new silicone varnish is that electrical equipment can be baked fully assembled without damaging the commutators or the slip rings. The temperature required to cure DC 996 does not affect shellac-bonded mica or core plating.

This new silicone varnish which was developed to provide manufacturers of new equipment and rewinders of old equipment with a heat resistant, waterproof silicone varnish requiring no special equipment or curing and no special techniques for successful application.

Vertical Motor

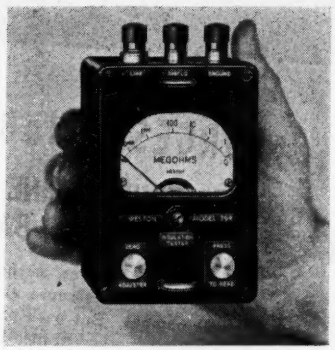
THE CROCKER-WHEELER DIVISION of Joshua Hendy Iron Works, Ampere, N. J., announces a new addition to the Company's line of Protected-Type a-c motors. It is a vertical dripproof motor which is rated at 40 C rise continuous duty with a 15 per cent service factor, and is designed for operation from 60 or 50 cycle, 3 or 2 phase circuits at all standard voltages.

All ventilating openings of this new line of motors are shielded against the entrance of dripping liquids and falling particles. Oversize ball bearings are provided to carry thrust in addition to the rotor, and the use of the company's patented centrifugal bearing seal permits the use of softer grease for better lubrication and longer bearing life.

A new recessed junction box, which provides ample room for making electrical connections, is employed in the motor's design.

Insulation Tester

AN EXTREMELY sensitive direct-reading insulation measuring device for applications where high testing potentials are not desired, has been developed by Western Electrical Instrument Corp., 617 Frelinghuysen Ave., Newark 5, N. J., and is known as Model 799. It provides a single range for readings from 0.1 megohms to 10,000 megohms; with the 10,000 mark at 8 per cent of the scale length, thus providing good readability. The circuit has a test potential of less than 50 v dc. An electrical guard circuit is provided for



elimination of surface leakages when testing cables. Thus the Model 799 is finding broad application throughout the electrical industry and in many other industries as well.

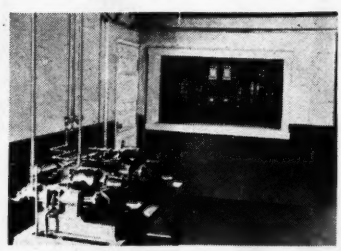
In electrical testing, for example, it replaces expensive or specially built test stands, for checking leakage between windings in transformers, cable resistance, leakage of low-voltage paper and mica condensers without damaging the dielectric, and for numerous other tests.

The size of Model 799 is only 5⅝ by 3¼ by 4⅞ in. All exposed metal parts are thoroughly insulated for operator's protection. A "press-to-read" switch automatically disconnects battery circuit when not in use. Ferrules in panel permit attachment to lineman's belt or shoulder strap.

Automatic Water Treating Equipment

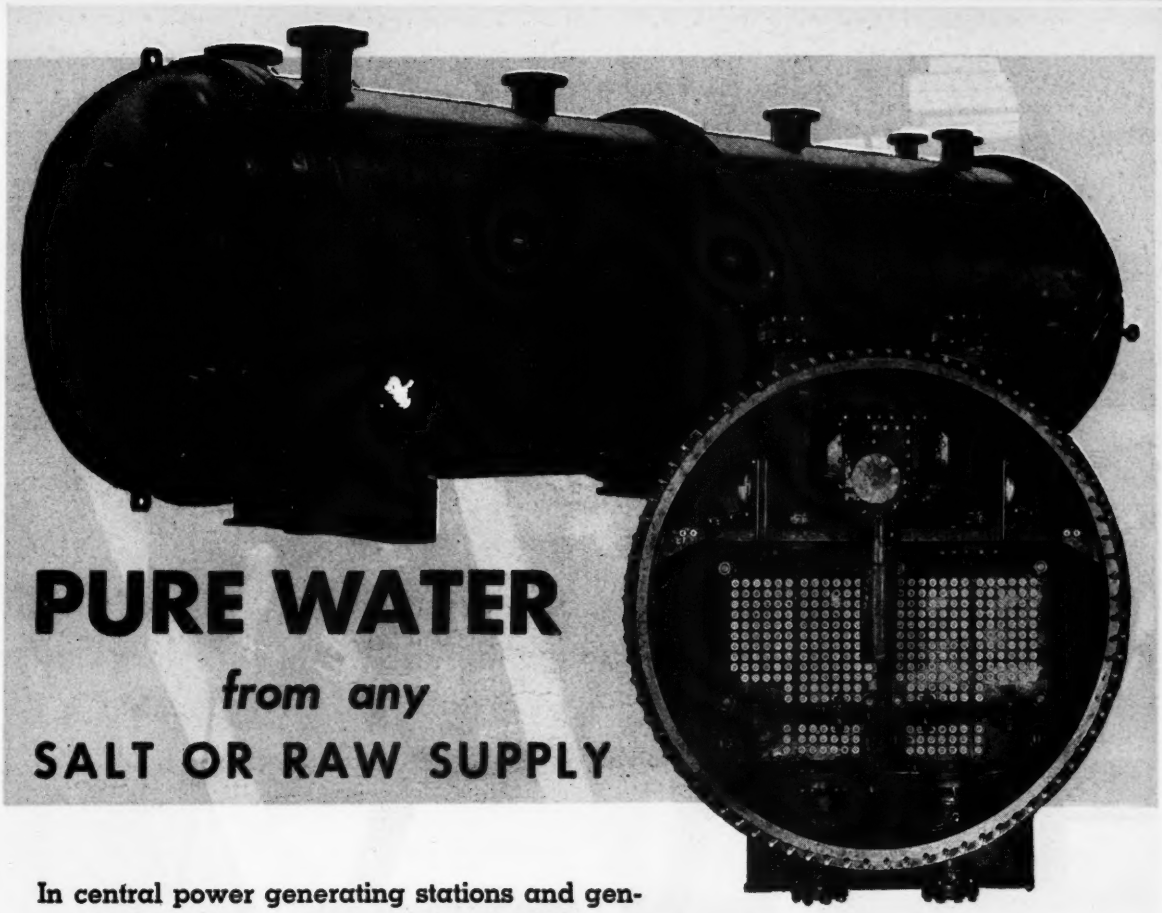
AN INTERESTING APPLICATION of electronics is shown in the accompanying illustration of equipment in the plant of the Village of Cobleskill, N. Y., where a completely automatic chemical feed system controls treatment of the water supply.

Two duplex chemical pumps feed activated carbon, alum and soda ash in direct proportion to water flow averaging one-half million gallons daily. Thymotrol controls, mounted on a panel board and actuated by a Sparling meter in the main water



line, regulate the speed of the pump motors, thus feeding testing chemicals in quantities exactly proportional to varying water consumption.

Controls function instantly with the meter and motors respond instantly to the controls, thus there can be no deviation from predetermined percentages of treating agents. The edge of the tank at extreme right is one of the pressure filters. Pumps and controls were furnished by Milton Roy Pumps, Philadelphia.



PURE WATER

from any
SALT OR RAW SUPPLY

In central power generating stations and general industrial plants . . . on naval and commercial vessels . . . in refineries and chemical process plants . . . wherever pure water is required for boiler feed make-up, process work, or general services . . . G-R Evaporators have established records for dependable, economical operation. These units do not require hand-scaling, and can be maintained by unskilled labor. Varying raw water conditions do not affect the product under wide limits. The distillate produced meets the exacting purity requirements of present day practice.

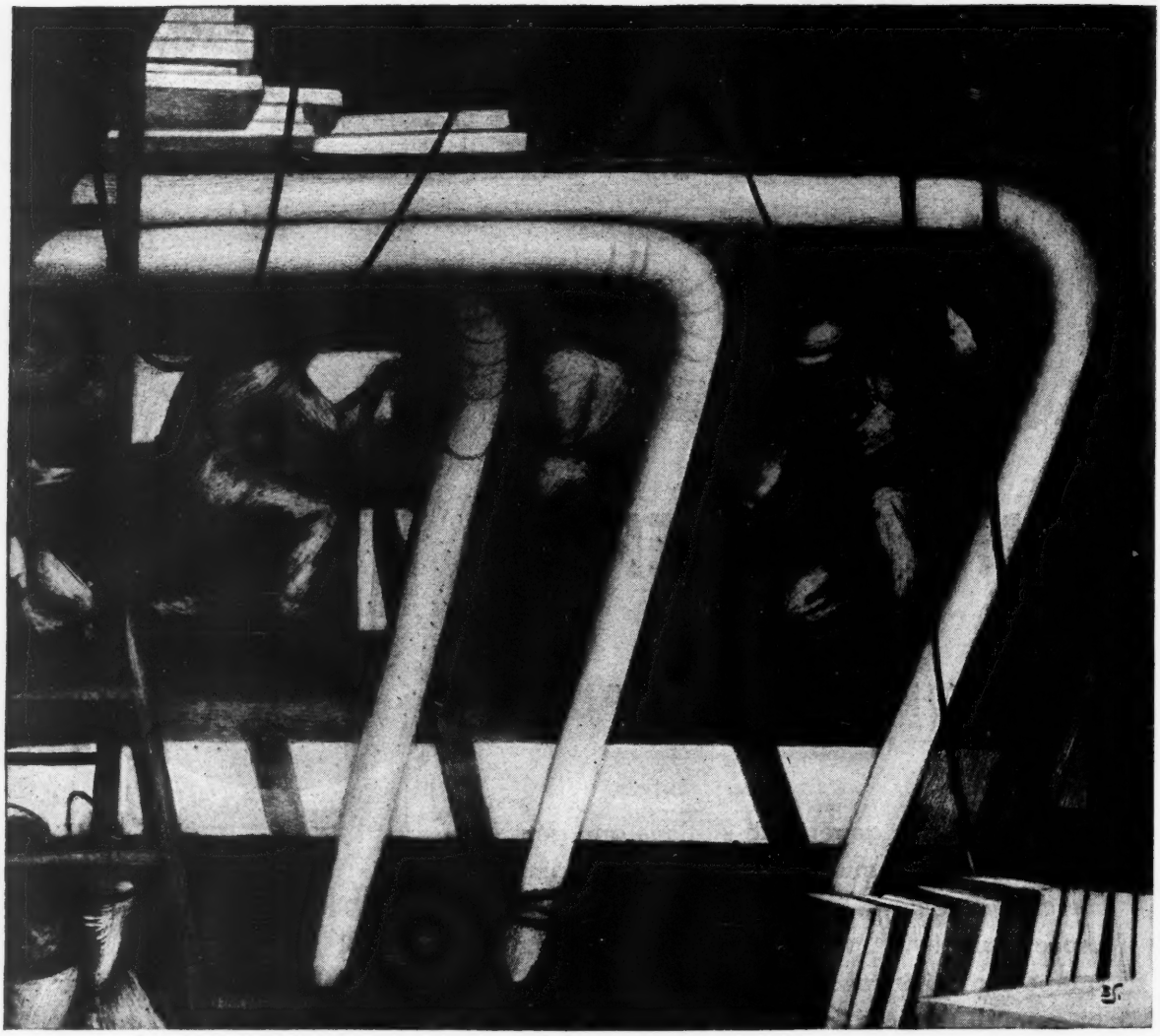
Look into this G-R BENTUBE EVAPORATOR

Note the rugged construction, unusually large clearances, and widely spaced tubes. The heating surface of this unit consists of patented scale-shedding Bentube elements. Temperature variations change the curvature of the tubes, thereby shedding the scale. G-R Bentube Evaporators can be furnished for large or small capacities, and in single or multiple effects for any requirements.

THE GRISCOM-RUSSELL CO., 285 Madison Ave., New York 17, N. Y.

GRISCOM-RUSSELL

Pioneers in Heat Transfer Apparatus



ORIGINAL LITHOGRAPH BY BENTON SPRUANCE

INVEST IN... *Insulations*

The return on the money invested in adequate insulation for boilers, steam lines and heated equipment is more than many people realize. It is not unusual to find that savings actually pay for a job in less than a year—with the return continuing, indefinitely, throughout the years that follow.

In selecting insulations, however, be sure to choose highly-efficient, long-lived, dependable materials . . . such as Ehret's 85% Magnesia or Enduro. This will ensure the permanency of your investment as well as a continuously high rate of return on your insulation dollars.

THE EHRET HEAT INSULATION HANDBOOK *contains a wealth of information on 85% Magnesia, Enduro high temperature and many other insulations—with selection and application data for boilers, piping and equipment. Fully illustrated, it includes heat loss and efficiency tables, specifications and recommendations for every temperature condition. A copy will be sent at your request.*

EHRET

MAGNESIA MANUFACTURING CO.

VALLEY FORGE • PENNSYLVANIA

PLAN TODAY...
TO MOVE COAL THE G-W WAY

Suppose your coal-handling problem is to install a conveyor-elevator system for storage and distribution of coal to bunkers, and from there to stokers or pulverizers. One way it could be solved is graphically illustrated by this composite photo and diagram. The installation shown comprises *standard* G-W equipment co-ordinated into a handling system meeting *specific* requirements—the moving of coal, mechanically, from car to live storage and reserve storage . . . thence to the boiler room. Or your problem may be to install the best type of conveyor to distribute coal evenly and with no segregation throughout the bunkers . . . or, where a number of boilers are served by a common bunker, to decide whether movable spouts or traveling weigh larries will deliver the coal with greatest efficiency and economy.

To these problems, and many others, G-W experts bring specialized experience as designers and builders of coal storage and coal and ash handling systems for over 130 years. In this time Gifford-Wood has not only developed efficient standard equipment but has acquired experience which particularly qualifies them to design, build and install special systems to meet unusual conditions. Gifford-Wood Co.,
420 Lexington Ave., New York 17, N. Y.;
565 W. Washington St., Chicago 6, Ill.
Factory—Hudson, N. Y.

DO YOU KNOW?—G-W is also *Handling Headquarters* for Industrial Conveying and Elevating Systems . . . for Ice Handling Tools and Ice Processing Equipment . . . for Infra-Red Baking and Drying Systems . . .

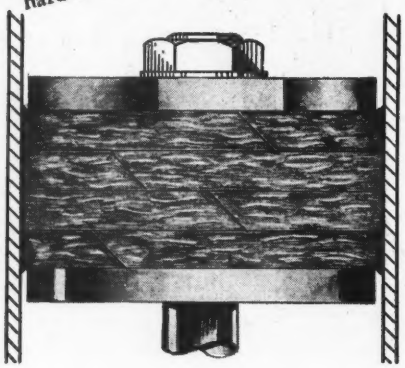
G-W HANDLES IT
Faster · Easier · Cheaper

GIFFORD-WOOD
SINCE 1814

How does *your* pump operate?

. . . . . Is it a PLUG?

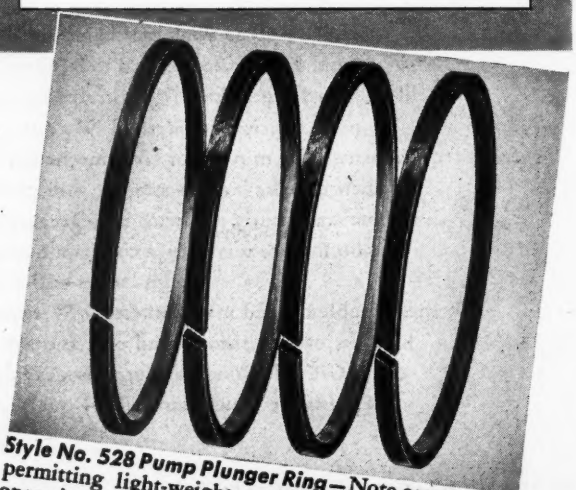
Does it run roughly and stick because hydraulic packing has swollen-up to score cylinder walls and slow operation? See how gap openings are forced together making one solid hard mass.



Or a FLOATING Piston?

Does it work smoothly and evenly with Sea-Ro rings? See how gap is spaced and with proper gap opening there is no jamming. Float tolerance allows ring to maintain steady, yet resilient contact with liner.

FOR better, worry-free pump operation, we suggest you give Sea-Ro #528 pump plunger rings a trial next time new packing must be installed. These resilient, laminated phenolic composition rings, which are impregnated with graphite, are engineered and designed for low friction, high temperature and pressure. Let our engineers study your pump problems. Write for new catalogue. No obligation.



Style No. 528 Pump Plunger Ring—Note gap opening permitting light-weight, resilient ring to "float" in operation.

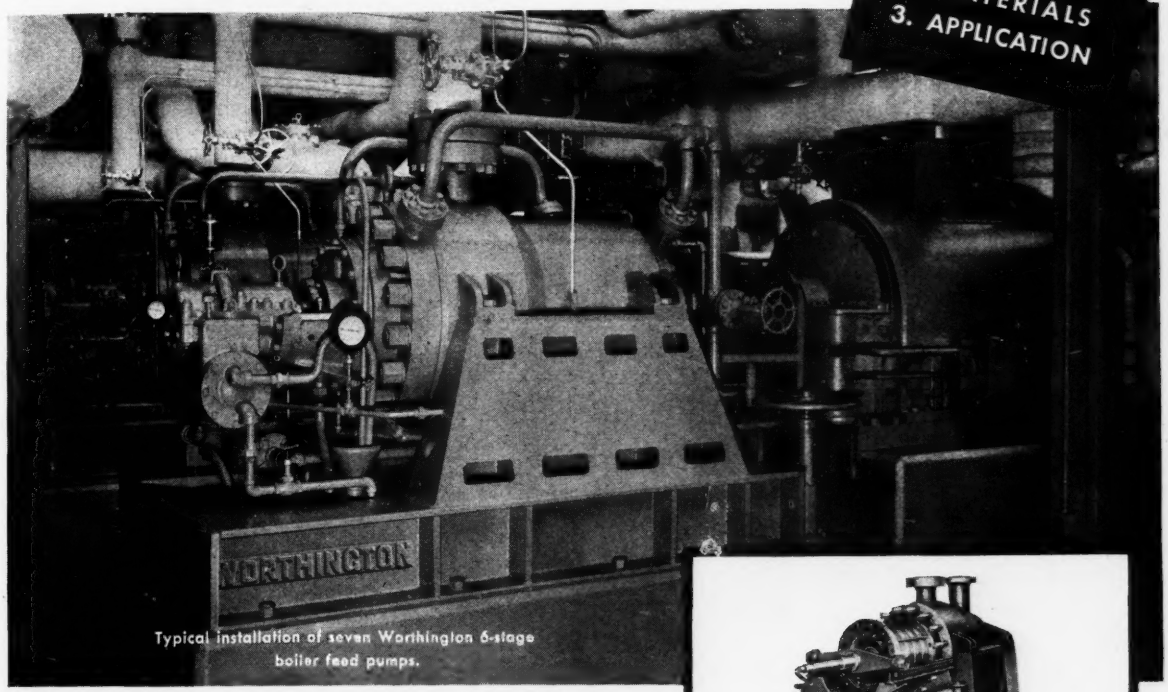
SEA-RO

PUMP PLUNGER RINGS
NEK-SEAL PACKING

SEA-RO PACKING COMPANY • WOOD-RIDGE, NEW JERSEY

WHY WORTHINGTON HIGH-PRESSURE PUMPS *excel in all three . . .*

1. DESIGN
2. MATERIALS
3. APPLICATION



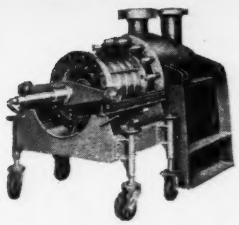
Typical installation of seven Worthington 6-stage boiler feed pumps.

1. DESIGN—Worthington has longer experience in manufacturing high-pressure centrifugal boiler feed pumps . . . has acquired unique constructive ideas from power-plant operating engineers. That's why you'll find such superior design features in Worthington high pressure boiler feed pumps as: a balancing device construction that minimizes wear; bolted ring-type pressure joints; impellers shrunk on the shaft; oversized Kingsbury thrust bearings.

2. MATERIALS—Worthington has greater facilities for research. That's why you'll find the *right* materials in Worthington high-pressure boiler feed pumps: stainless steel for internal parts—to prevent destructive corrosion and erosion; forged steel casings—tested and proved by years of power plant operation.

3. APPLICATION—Worthington Pump Application Engineers are thoroughly versed in every phase of applying the most complete line of boiler feed pumps for high or low pressures — capacities from 50 to 3500 GPM . . . pressures from 50 to 2500 PSI. That's why Worthington will fit the *right* feed pumps to your feed cycle.

For further details on Worthington High-Pressure Boiler Feed Pumps . . . or for an appointment with a Worthington P.A.E.*, write us or telephone the nearest of our 36 district offices. You'll find that *there's more worth in Worthington. Worthington Pump and Machinery Corporation, Centrifugal Pump Division, Harrison, N.J.*



AS EASY TO DISMANTLE AND ASSEMBLE AS A SPLIT-CASE PUMP

Complete rotor assembly of Worthington High-Pressure Boiler Feed Pump can be withdrawn *in one piece* on a portable assembly truck without disturbing suction or discharge piping connections. Simplifies inspection, replacement or repair of internal parts.

*Pump Application Engineer

WORTHINGTON

24C5-3

THE WORLD'S LARGEST MANUFACTURER OF PUMPS

For Boiler Feed Service
Capacities from 30 to 1500 g. p. m. Heads from 180 to 1000 feet.

For Hotwell, Condensate, Chilled Water, General Service
Capacities from 150 to 1300 g. p. m. Heads from 110 to 500 feet.

For Boiler Feed Service
Capacities from 25 to 1450 g. p. m. Heads from 220 to 1600 feet.

For Water Works, Circulation, Drainage, General Service
Capacities from 500 to 1600 g. p. m. Heads 900 to 3200 feet.

For Boiler Feed Service
Capacities from 200 to 1600 g. p. m. Heads from 900 to 3200 feet.

For Boiler Feed Service
Capacities from 500 to 3000 g. p. m. Heads from 2000 to 7000 feet.

You can be Sure of Uniformity and Quality when you Specify Globe !

Extra care in production control assures uniformity and quality in all classes of Globe steel tubes. Unvarying quality is safeguarded and production methods and materials exactly controlled by one of the largest and complete chemical and physical laboratories of its kind, concentrating on tubing characteristics and problems.

You can be sure of uniformity and quality when you specify Globe tubes — pressure, mechanical, or stainless.

GLOBE STEEL TUBES CO., Milwaukee 4, Wis., U.S.A.

GLOBE STEEL TUBES

5019

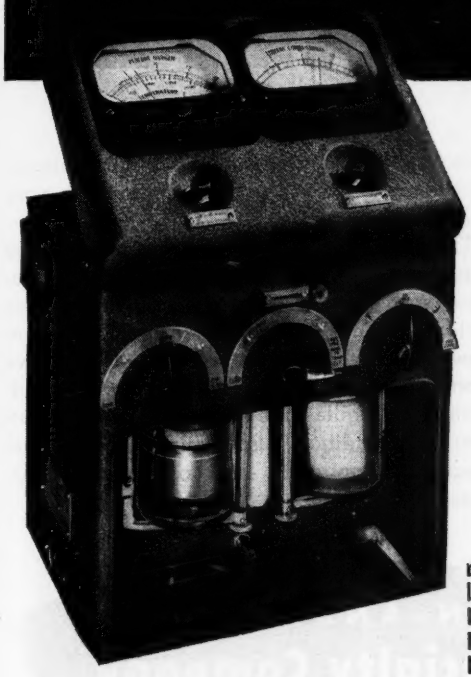
★ Pressure Tubes
★ Condenser & Heat Exchanger Tubes
★ Seamless Stainless Steel Tubes

GLOBE TUBES

★ Mechanical Tubing
★ Gloweld Welded Stainless Steel Tubes
★ Globeiron High Purity Iron Seamless Tubes

How efficiently are you Burning Fuel?

YOU CAN FIND OUT—IN JUST A FEW MINUTES—WITH THE CITIES SERVICE INDUSTRIAL HEAT PROVER



This unique instrument indicates simultaneously the percentage of unburned fuel, or oxygen present in the flue gases.

With this data the Cities Service engineer can show you at once how to *save* on fuel costs.

The Industrial Heat Prover has been applied with uniformly successful results to every kind of fuel and to every type of combustion equipment in this country.

Also used successfully for controlling furnace atmospheres in the heat treatment of steel.

For a demonstration of the Industrial Heat Prover on your own equipment, contact your nearest Cities Service office or mail the coupon below.

MAIL THIS COUPON TODAY

(Available only in Cities Service Marketing Territories East of the Rockies)

Cities Service Oil Co.
Room 444, 70 Pine Street
New York 5, N. Y.

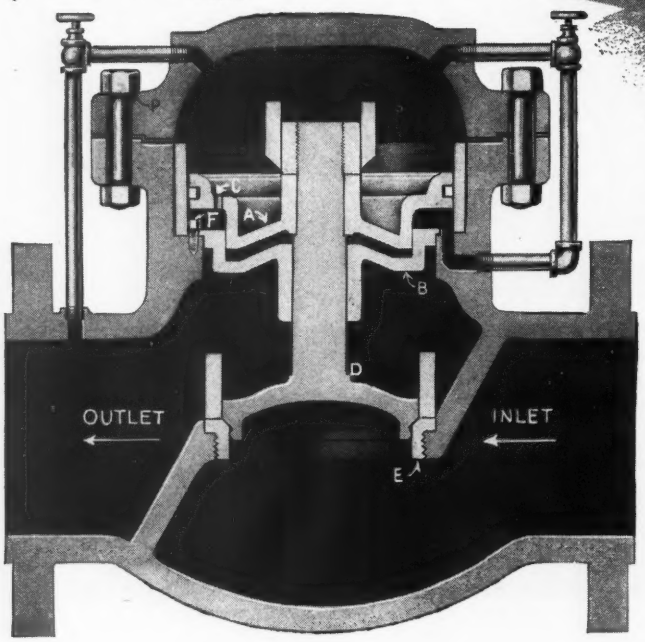
Gentlemen: Please send me further information on the Cities Service Industrial Heat Prover—at no obligation to me.

Name.....
Title.....
Company.....
Address.....
City..... State.....

CITIES SERVICE OILS
ONCE-ALWAYS

Engineered PROTECTION

FOR HIGH PRESSURE BOILER FEED LINES



GOLDEN-ANDERSON HYDRAULIC *Double-Cushioned* CHECK VALVES

Look to Golden-Anderson Valves for maximum *engineered safety and protection* in your boiler room.

This valve is an excellent example of the outstanding engineering built in every Golden-Anderson Valve. Designed for high pressure boiler feed lines, the double cushioning feature prevents any shock or jar in sudden valve closure. Needle valve control allows close adjustment to regulate the operating speed for *any* operating condition. Also available with manual handwheel control, in angle or globe patterns, sizes 2½" to 14"

Other GOLDEN-ANDERSON **Automatic Valves**

- Non-Return Valves
- Throttle and Automatic Engine Stop Valves
- Emergency Trip Valves
- Pressure Reducing Valves
- Altitude Control Valves
- Float Operated Control Valves
- Coke Quenching Valves
- and many other types for safe, dependable flow control.

GA

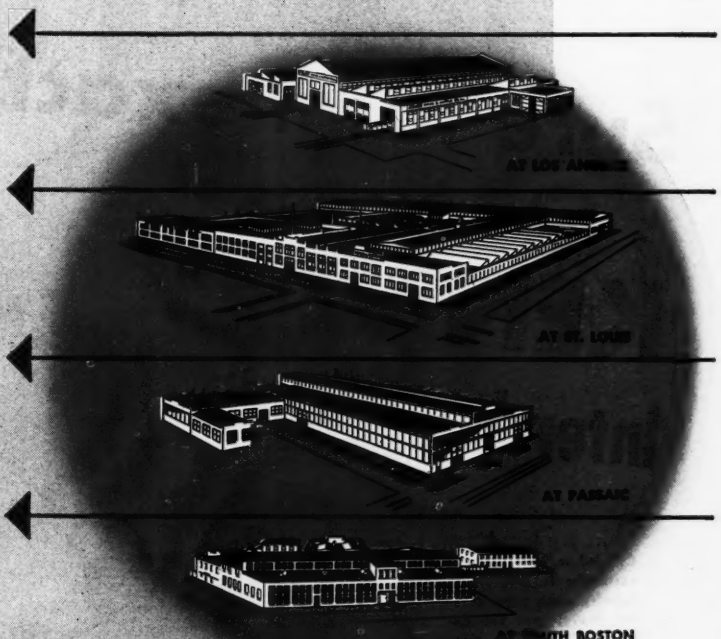
Write for descriptive technical catalog!

GOLDEN-ANDERSON VALVE **Specialty Company**

FULTON BUILDING • PITTSBURGH 22, PA.

TO THE USER OF FABRICATED PIPING

4 PLANTS *Are Better* THAN 1



There are four Midwest pipe fabricating plants located in different parts of the country, because Midwest has found that "four plants are better than one" for the user of piping.

In addition to shortening shipping distances and making for a better understanding of the customers' individual problems, four plants provide other important benefits in which all Midwest Piping users participate.

Extra reserve capacity is provided for the emergency job. If extreme speed is sufficiently important, a job can be divided among two or more plants. An overload in one plant often can be handled by temporarily transferring skilled workers from other plants.

One of the greatest advantages is the continuous exchange of information and experience between staff members of the four plants. New techniques developed in one plant are made known to all. Piping problems which may be new to one plant probably are very familiar to another where the "know how" information is available at once. Friendly rivalry—constant study of piping problems by four organizations—tends to advance the art of piping fabrication much more rapidly than would otherwise occur.

All of this works to the advantage of piping users —four plants are better than one.

Midwest can give you better piping and better service . . . whether you need only a simple bend or the most elaborate piping job completely erected and ready for operation.

1527

MIDWEST PIPING AND SUPPLY COMPANY, Inc.

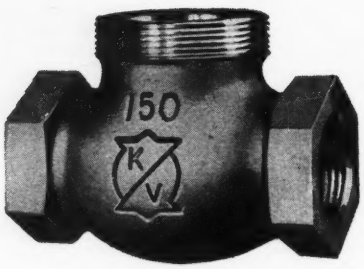
Main Office: 1450 South Second Street, St. Louis 4, Mo.
Plants: St. Louis, Passaic (N. J.) and Los Angeles
Subsidiary: Lumsden & Van Stone Co., South Boston 27, Mass.
Sales Offices: New York 7—30 Church St. Chicago 3—645 Marquette Bldg.
Los Angeles 33—520 Anderson St. Houston 2—229 Shell Bldg.
Tulsa 3—533 Mayo Bldg. Atlanta 3—Red Rock Bldg. South Boston 27—426 First St.

PIPING FABRICATORS AND CONTRACTORS

"Trifles make perfection but perfection is no trifle"

Sure to fit exactly because of KENNEDY Interchangeability

One of a series of advertisements explaining how Kennedy gives careful attention to the details of valve design, construction and workmanship that provide maximum effectiveness, convenience, and length of service.



With a given size and type of valve, it doesn't matter what Kennedy globe or angle body you pick . . . the stem and bonnet assembly will fit exactly, and the valve will operate perfectly.

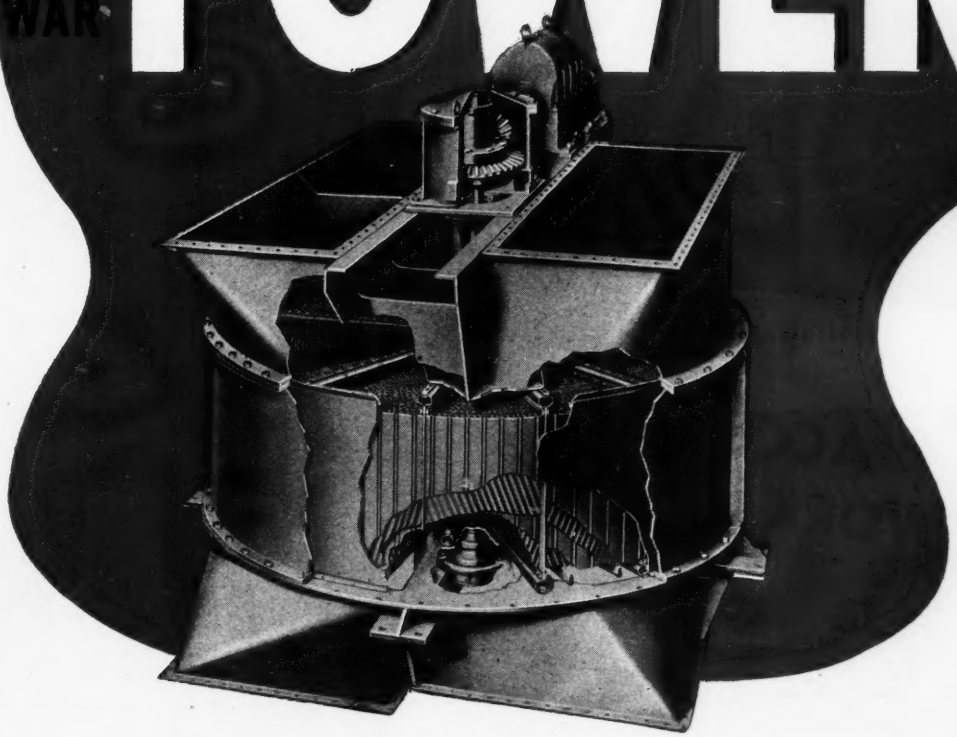
This feature indicates our precision machine work throughout every Kennedy valve type. That's one of many reasons why so many experienced plant engineers insist on Kennedy Bronze and Iron Body Gate, Globe, Angle and Check Valves, and why it will pay you, too, to use these high-quality valves for all your standard requirements.

THE KENNEDY VALVE MFG. CO.
ELMIRA • NEW YORK

KENNEDY *valves . . . pipe fittings . . . fire hydrants*

WHEN YOU THINK OF POST-WAR

POWER



THINK OF PREHEAT ENGINEERING

In planning plant reconversion for competitive production, don't overlook savings that start in the power house. To make sure your power and steam-generation requirements are fully met on a waste-free basis, it will pay you to check the possibilities of *higher heat recovery with* the Ljungstrom Air Preheater.

THE LJUNGSTROM AIR PREHEATER

The Ljungstrom operates on a continuous, regenerative, counterflow principle, providing maximum heat transfer with minimum weight and size. The rotating, cylindrical, heat-transfer surface adsorbs heat in the flue-gas chamber, then rotates to the chamber where it transfers this heat to the entering air. Wide usage on high-efficiency utility steam plants has proved its substantial fuel savings. Broad application to industrial heat processes is evidence of versatile usefulness.

THE

AIR PREHEATER

CORPORATION

Executive Offices: 60 East 42nd Street, New York 17, N. Y. • Plant: Wellsville, N. Y.

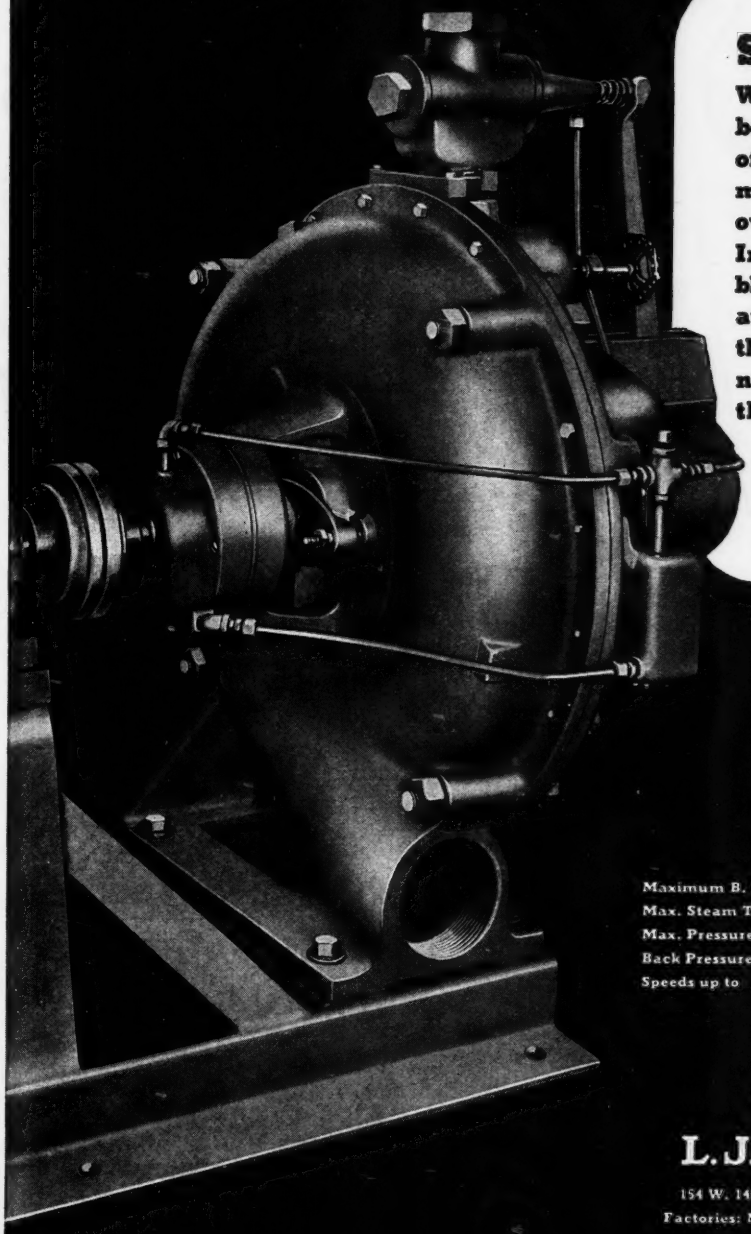
ACCURATE WORKMANSHIP

The measure of any piping system, after the proper design has been reached, is the "fit." The knowledge which we have gained in the past 40 years is your guarantee of an accurate and workmanlike piping system. Navco quality in workmanship and design is evidenced by the many successfully operating installations which we have made for every industry. Consult Navco for your next piping job.

NAVCO

NAVCO PIPING

NATIONAL VALVE & MANUFACTURING COMPANY • PITTSBURGH, PA.



SIMPLICITY

Wing Steam Turbines have been a dependable source of power in industrial and marine applications for over a third of a century. In the operation of fans, blowers, pumps and other auxiliary drive equipment, their simplicity, their economical performance and their ability to stand up under adverse conditions are outstanding characteristics.

OPERATING RANGES

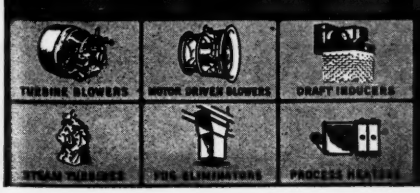
	STANDARD	HIGH PRESSURE
Maximum B. H. P.	100	150
Max. Steam Temp.	525 F.	750 F.
Max. Pressure	275 lbs.	600 lbs.
Back Pressure up to	50 lbs.	50 lbs
Speeds up to	4000 RPM	4000 RPM

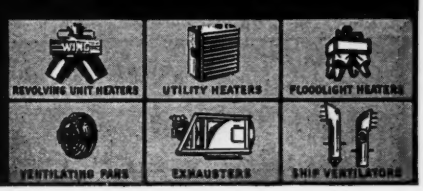
Write for Bulletin SW-1

L. J. Wing Mfg. Co.

154 W. 14th St., New York 11, N. Y.
Factories: Newark, N. J. and Montreal, Canada

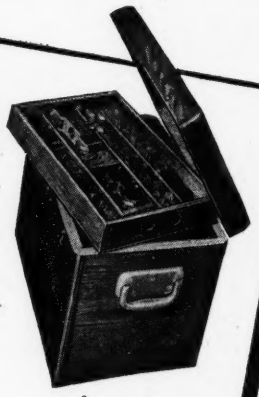
Wing TURBINES





AS STEAMFITTER, I'M THE ONE WHO USES

DEXTER VALVE RESEATING MACHINES AND CUTTERS



We don't have extra helpers around the plant these days. Every man has more than enough work ahead of him. That's one big reason why we're so happy with our new Dexter Valve Reseating equipment.

One man can reseat a leaky valve right on the line, in just a few minutes, the Dexter Way. No more costly delays and long shutdowns while we gather a crew, break out the leaky valve and replace it — even if we could get a replacement.

We've found that the Dexter outfit is more than just a kit of tools — it's a scientifically engineered unit that saves us time and money every day.

RESEATS ANY GLOBE, GATE OR PUMP VALVE ON STEAM, AIR, WATER AND OIL LINES

Delivery in 60 days! Our non-military manufacturing facilities are catching up with our back orders, and we are now able to promise delivery in 60 days.

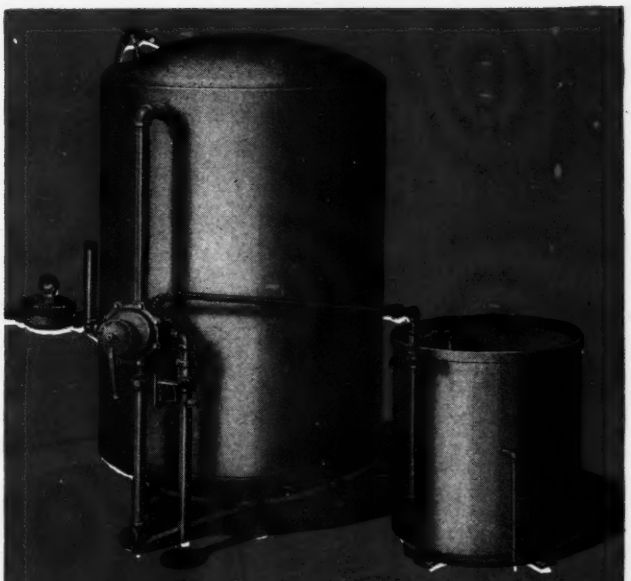
Write us full particulars of your leaky-valve problems — make, size, type and material, use and pressure. We'll suggest our solution, without obligation.

24

THE LEAVITT MACHINE COMPANY
ORANGE, MASSACHUSETTS

7 features

NO OTHER WATER SOFTENER CAN MATCH!



Latest design Elgin Water Softener

1 DELIVERS 44% MORE SOFT WATER
In comparison with other zeolite water softeners the Elgin delivers as much as 44% more soft water.

2 LOWER INVESTMENT
Based on cost per thousand gallons of soft water delivered, the Elgin Water Softener is far lower in price.

3 LOWER OPERATING COST
By virtue of an improved distributing and collecting system, less regenerating salt and wash water are required.

4 HIGHER EFFICIENCY
The water softening zeolite in the Elgin is kept clean and active so that equipment operates more efficiently without attention—and more "zero-soft" water is delivered per pound of salt used.

5 LESS MAINTENANCE
Unbiased surveys prove that with ELGIN quality construction throughout, fewer replacements are required. Loss of zeolite is prevented, thus eliminating costly additions.

6 LONGER LIFE
Efficient distribution, collection and regulation of water and brine add years to the life of Elgin Water Softeners.

7 LESS SPACE REQUIRED
To give the same capacity as an Elgin, other water softeners must be as much as 50% larger in size.

WHY THE ELGIN GIVES GREATER CAPACITY AND HIGHER EFFICIENCY

There is nothing mysterious about the increased soft water output and the higher efficiency of the Elgin Water Softener. It simply accommodates a far greater quantity of water softening zeolite and uses it more effectively by virtue of an ingenious manifold system and backwash regulator. Naturally a greater volume of soft water is delivered because it's the zeolite that softens water—and more zeolite used with greater effectiveness means more softened water. Add to this the outstanding quality and the high capacity feature of Elgin water softening zeolite and you have the whole story in a nutshell.

Bulletin 603 gives all the facts. Write for your copy today.

Existing water softeners of any make can be modernized by Elgin to provide the above features.

ELGIN SOFTENER CORPORATION

SOFTENERS ★ FILTERS ★ WATER TREATMENT ★ BOILER WATER CONDITIONING

As SIMPLE and POSITIVE as a Water Wheel

That's the reason for the LOW COST and ACCURACY of the

ADSCO ROTARY CONDENSATION METER

WHENEVER it is possible to collect the condensate from heating or processing lines in a building or department, you can measure your steam consumption accurately with inexpensive ADSCO Rotary Condensation Meters.

These low priced meters detect steam losses and are as positive as a water wheel — so accurate that the slightest trickle of condensate is recorded on direct reading counters.

Tell us the maximum pounds of condensate per hour or the square feet of equivalent direct radiation in the building or department to be metered and we will tell you how surprisingly little it will cost to put your steam consumption on a sound accounting basis. Ask for Bulletin 35-80 and No. 35-83E.

ADSCO FLOW METER

For measuring the flow of steam, water, air or gas, no other meter is so simple or rugged. Recommended where a 24 hour visual chart record of flow, an indication of the pressure and a totalization of the flow through the line is desired.

AMERICAN DISTRICT STEAM COMPANY

NORTH TONAWANDA NEW YORK

Makers of "UP-TO-DATE" Steam Line Equipment For Over 65 Years

Obituaries

Elmer E. Gilbert

ELMER E. GILBERT, retired sales manager of the General Electric Co.'s turbine division and a pioneer in the development of the turbine industry, died in Schenectady, August 26, 1945. He was 78 years old.

His career of more than 43 years with General Electric spanned the period of development of the steam turbine. He was in charge of turbine-generator sales from the time G. E. entered the field until his retirement in January, 1933.

Mr. Gilbert received his training as an electrical and mechanical engineer at Rose Polytechnic Institute, Terre Haute, Indiana, from which he was graduated in 1889. A short time later he accepted employment with the Thomson-Houston Electric Co. at Lynn, Mass., which was combined with the Edison General Electric Co. at Schenectady to form the General Electric Co.

In January, 1891, Mr. Gilbert was transferred to New York, and after the formation of General Electric, he was a member of the lighting department sales staff in that city. He was assigned to the General Office at Schenectady in 1898, as an assistant to S. Dana Greene, then manager of the lighting department.

At that time turbine experiments were already being conducted at the Schenectady Works, but no commercial turbine was ready for the market. Success in this work came about 1900, and in February, 1903, a 500-kw Curtis turbine was installed at Newport, R. I., for the Newport Street Railway Co., largely as an experiment in commercial operation.

The turbine manufacturing activities of General Electric progressed rapidly, and in 1906 the sale of turbine-generators was transferred from the lighting department to a new turbine sales department, of which Mr. Gilbert was made sales manager.

The largest single-unit turbine now operating was produced by General Electric shortly before Mr. Gilbert's retirement. It is the type installed for the Brooklyn Edison Co., rated at 160,000 kw. Such was also the case with the largest compound-unit type, a 208,000-kw turbine-generator bought by the Chicago District Generating Corp.

Adolphus Mansfield Dudley

ADOLPHUS MANSFIELD DUDLEY, retired Westinghouse engineer died suddenly at his home in Oakmont, Pa., on August 16, 1945. He was widely known for his contributions to professional engineering, engineering education and technical writings.

Mr. Dudley was born in Cincinnati, Ohio, on February 14, 1877, and after completing his preparatory education at the Hughes High School there he enrolled at the University of Mich-

Specialists IN STEEL CASTINGS FOR VALVES—FITTINGS

● A sharp upswing in temperatures and pressures began nearly half a century ago. The need for cast steel valves and fittings became apparent. And that's when Reading began to specialize in *pressure* steel castings.

Early development was a matter of experimenting, recording experience and studying the records. But, as pressures and temperatures continued to rise, the demand was for ever higher standards in valves. Reading met the challenge with improved manufacturing methods. Melting processes were refined from converters to open hearth furnaces, then to electric furnaces. Control and investigational methods, such as photomicrographs, radiography, new methods of sand-testing and slag control were developed and improved.

Such developments produced castings in either carbon steels or alloys to use in valves to meet today's exacting requirements—valves and fittings which safely and reliably handle present-day high temperatures in the steam services and the gases and oils of the petroleum industry.

R-P&C offers you a single responsible source for bronze, iron and steel gate, globe, angle and check valves—cocks and Lubrotite gate valves—bar stock valves—cast steel fittings—D'Este Automatic Regulating Valves.

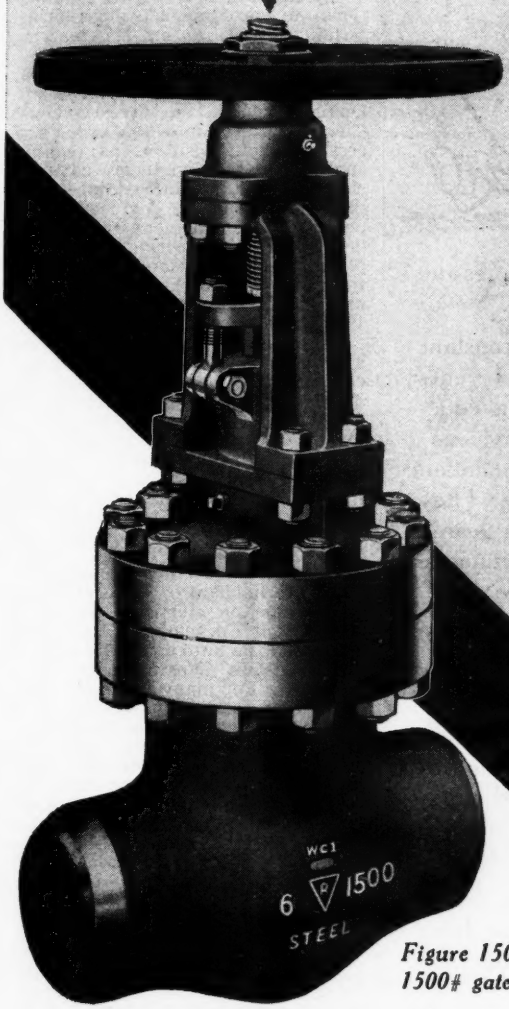


Figure 15004
1500# gate valve

READING-PRATT & CADY

MANUFACTURERS OF
READING CAST STEEL VALVES AND FITTINGS • PRATT & CADY BRASS AND IRON VALVES
D'ESTE AUTOMATIC REGULATING VALVES

ACCO

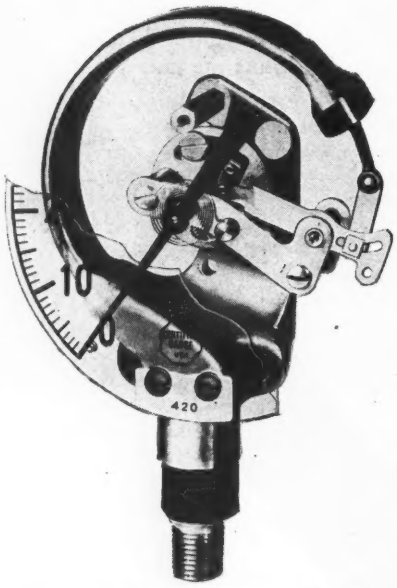
Reading, Pa. • Atlanta • Boston • Chicago • Denver • Houston • Los Angeles • New York • Philadelphia • Pittsburgh • San Francisco • Bridgeport, Conn.

READING-PRATT & CADY DIVISION
AMERICAN CHAIN & CABLE

TRADE MARK

Ruggedness may mean a variety of things. In Certified pressure gauges it results in continued accuracy over a long pull.

Those companies who have had Certified gauges in constant service for several years know that it means a reduction in maintenance expense and the elimination of a lot of trouble. They know that any spur geared movement gauge cannot be rugged in the same sense.



The rugged Certified gauge assembly with Korex steel Bourdon tube fused to forged steel socket and tip, and with the Helicoid movement. For all pressures from 15 to 10,000 lbs.

It's been the experience of users that Certified gauges definitely save money by cutting down repair cost.

The reason is the ruggedness of the Certified gauge system, plus the inherent durability of the Helicoid movement.

Only Certified gauges have the Helicoid movement.

ARMY E NAVY

Certified GAUGE
AND INSTRUMENT CORP.

igan. He received the Bachelor of Science degree in engineering in 1902 and the degree of Electrical Engineer in 1931 at the Ann Arbor institution. Later, he matriculated at the University of Pittsburgh where he received the Master of Science degree in 1933. He was made an honorary member of two national honorary engineering societies, the University of Michigan Chapter of Tau Beta Pi and the University of Pittsburgh Chapter of Sigma Tau. He was awarded the honorary degree of Doctor of Engineering by the University of Michigan in 1940 for his contributions to professional engineering, technical writings and engineering education.

Beginning his professional career in 1902 as an erecting engineer, Mr. Dudley joined the Westinghouse Electric Corp. in 1904. He successively held positions as: control engineer, design engineer, commercial engineer, section engineer, engineering manager, engineering supervisor of development, manager of development engineering, marine application engineer and engineering representative in the patent department until his retirement early in 1944.

As an engineer Mr. Dudley worked in the field of rotating electrical machine design; starting, lighting and ignition of automobiles; and the application of electrical machinery to marine uses, including propulsion.

His broad knowledge of electrical principles and application brought him naturally into the field of technical writing. He was author of "Connecting Induction Motors" and "Induction Motor Practice," which have gained wide favor among electrical technicians. He contributed the section on electrical motors in the current Encyclopedia Brittanica. He edited the autobiography of B. G. Lamme, late Westinghouse Chief Engineer. For many years Mr. Dudley served on the publication committee of "The Electric Journal."

Supplementing his professional interests, Mr. Dudley closely allied himself with educational activities. He taught for many years in the engineering and design schools conducted by Westinghouse as Westinghouse Lecturer in Electrical Engineering on the staff of the University of Pittsburgh.

Henry G. Acres

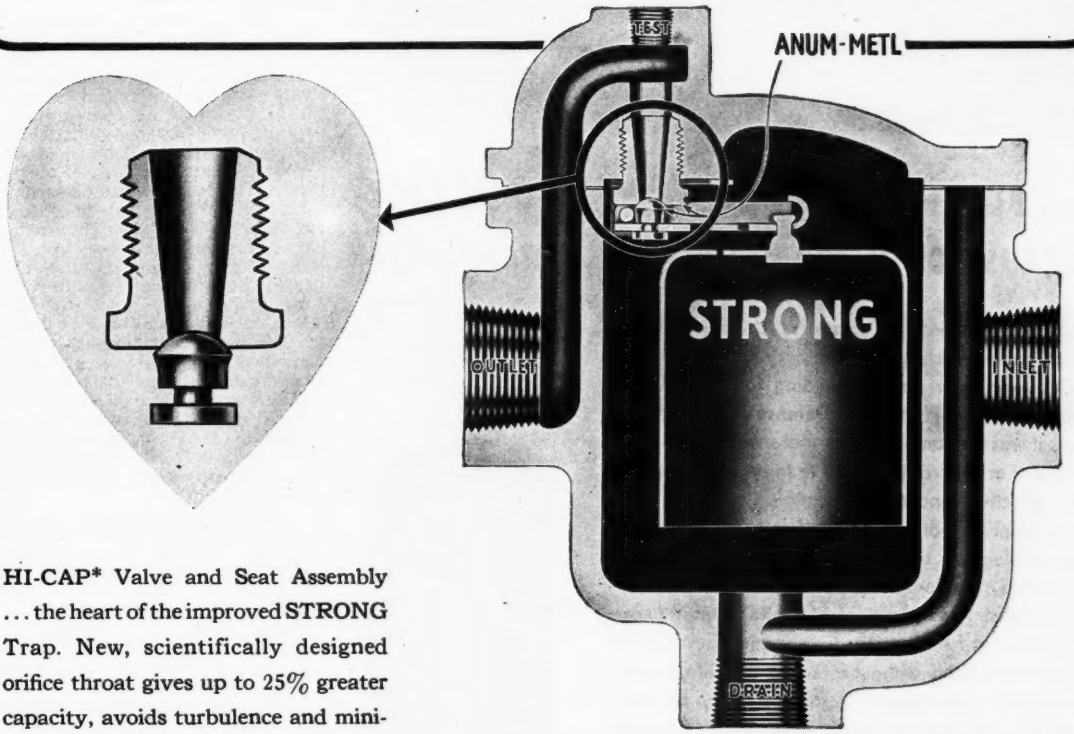
HENRY GIRDLESTONE ACRES of St. Catherines, Ont., one of Canada's leading hydro-electric engineers, died in a Toronto hospital Sept. 4 at the age of 65.

He gained wide prominence through his work in designing and supervising the Chippewa-Queenston development of the Ontario Hydro-Electric Power Commission and the Shipshaw development of the Aluminum Co. of Canada at Arvida, Que. The 1,200,000 hp Shipshaw project, largest localized power development project in the world, was opened in November, 1942.

As assistant mechanical engineer of the Canadian Niagara Power Co. in 1905, Mr. Acres placed in operation the first 10,000 hp turbine ever built. He was also in charge in 1907 of constructing the first 110,000 v transmission line ever built.

New HI-CAP Orifice Gives STRONG Traps

UP TO 25% GREATER CAPACITY



HI-CAP* Valve and Seat Assembly ... the heart of the improved STRONG Trap. New, scientifically designed orifice throat gives up to 25% greater capacity, avoids turbulence and minimizes choking caused by flash steam.

*HI-CAP—Registered trade mark

An important part of STRONG service is continued attention to parts for traps in service. HI-CAP parts are available for your present 70 series traps.

OTHER FEATURES OF THE NEW HI-CAP TRAP

NEW lever design gives quick, full opening without dribbling.

NEW renewable seat permits easy servicing.

NEW inlet-outlet location places trap below level of inlet pipe at all times.

Write for New Bulletin on HI-CAP Traps

STRONG, CARLISLE & HAMMOND COMPANY

Over 40 Years of Steam Specialties

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REG. TRADE MARK

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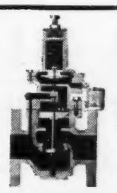
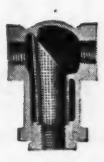
STRONG

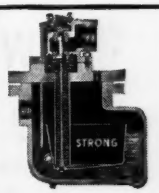
STEAM SPECIALTIES



Reducing Valves

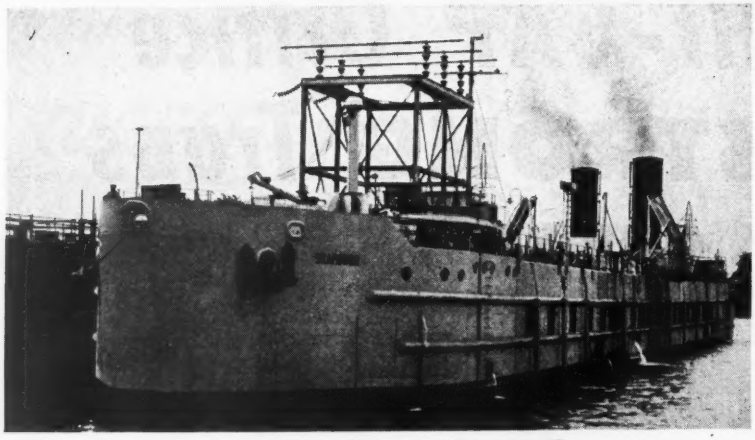


Strainers



Large Capacity Traps

"WATER, WATER EVERYWHERE"



. . . BUT NOT A DROP FOR *Cooling*

BECAUSE OF MICROBIOLOGICAL CONTAMINATION

That was the problem faced by United Engineers and Constructors — a problem solved by CHLORINATION — in their part of building four 30,000 KW Floating Power Plants* for Defense Plant Corporation. It was the same problem that every power plant — afloat or ashore — must solve to enjoy economical and effective condenser operation.

All cooling water is polluted to some degree by microbiological organisms which form insulating deposits on condenser water side surfaces. These deposits cause loss of heat transfer and result in excessive time out for cleaning. Chlorination destroys the organisms quickly without affecting tube life, and by *preventing* slime deposits regardless of the bacterial quality of the cooling water, saves labor, time and money.

In the case of these Floating Power Plants — intended for emergency use — the elimination of "time out" for cleaning was the prime consideration, but that is only one of the many savings which chlorination can give — one of the many benefits which W&T Engineers will be glad to show you following a survey of your particular problems. Why not call on them today?

**Designed, in collaboration with the U. S. Army Engineers, by Gielow Inc., and hulls built by Bethlehem Steel Co.*

WALLACE & TIERNAN PRODUCTS, INC.

Manufacturers of Chlorine and Ammonia Control Apparatus

Belleville 9, New Jersey • Represented in Principal Cities

CD–19S

MANUFACTURERS' *News*

Electrical Industry for Mexico

PLANS FOR THE CREATION of an electrical manufacturing industry in Mexico with the cooperation of American investors and Westinghouse technical assistance have been outlined by Kuhn, Loeb & Co., who have been collaborating with the Mexican Government and the Banco Nacional de Mexico.

A new company, Industria Electrica de Mexico, has been formed by cooperation of American and Mexican interests. It will be the largest privately-owned industrial corporation in Mexico, with an approximate capital of $15,000,000, of which $5,000,000 in bonds will be subscribed by Nacional Financiera, S. A. of Mexico, an agency of the Mexican Government.

The share capital of $10,000,000 will be subscribed in approximately equal proportions in the United States and Mexico. Kuhn, Loeb & Co. will head the American investment banking group and Banco Nacional de Mexico will head the Mexican group.

Estimates and designs for a large, modern electrical manufacturing establishment have been prepared by the Westinghouse Electric International Co., which will also provide training in Westinghouse plants in this country for certain manufacturing and operating personnel of the new company.

The plant will be built near Mexico City at a cost of approximately $10,000,000 for the initial unit. Equipment and machinery for the plant, including machine tools, furnaces, cranes, boilers and electrical installations will be purchased in the United States as needed, when the necessary priorities and export licenses are available.

The new company will manufacture or assemble motors, transformers, generators, switchboard and switchgear, refrigerators, home radios, and household appliances under agreement with Westinghouse for licensing and for technical assistance.

Test Laboratory for Elliott

CONSTRUCTION OF A new test laboratory to cost $750,000 and greatly extending the facilities of the research engineering division of the Elliott Co., Jeannette, Pa., has been announced.

Plans for extensive research and development on gas turbine power plants have called for the construction of a new main building, 60 by 140 ft and several small buildings separate and adjacent to it. Construction has been started and is expected to be completed within six months.

Located adjacent to the main Elliott factory at Jeannette, Pa., the new laboratory will be of windowless construction with uniform fluorescent lighting in addition to localized flood lights.

Year round forced-draft circulation, using filtered outside air will make

Controlling Pressure

with LADISH Controlled Quality Flanges

On installations where temperatures and pressures are high, Ladish Controlled Quality Forged Steel Flanges constantly prove their added value.

Produced under exacting metallurgical control, each Ladish flange bears the Controlled Quality symbol of dependability and peak performance . . . the Ladish Heat Code.

TO MARK PROGRESS

ARMY E NAVY

FITTINGS DIVISION

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CUDAHY • WISCONSIN (MILWAUKEE SUBURB)

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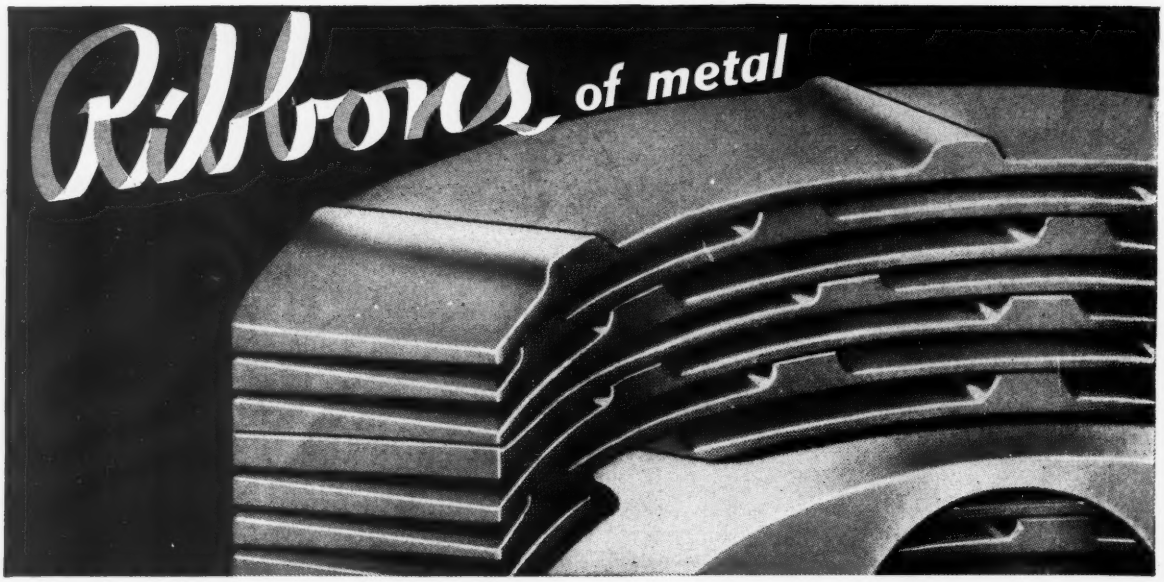


..that entrap particles and separate liquids!

Not woven wire cloth...not fabric... but *ribbons of metal*...do the filtering in an element developed by Purolator.

The principle is entirely new. The enlarged section (above) shows its construction.

A metallic ribbon is wound edgewise on a cylindrical perforated frame. At regular intervals, supporting projections occur. Their height determines the degree of filtration. Elements can be made with filtering gaps as small as 0.0005"; as large as 0.025".

In operation, the filtrate passes between the ribbons, leaving its solids on the outer edges. Clogging of the passages is prevented by the ever-decreasing cross-section of each ribbon.

Once Purolator had worked out the design, there still remained the big problem of finding a metal that would make the design practicable.

Such a metal had to be ductile and workable—to permit forming of the intricately-shaped ribbons.

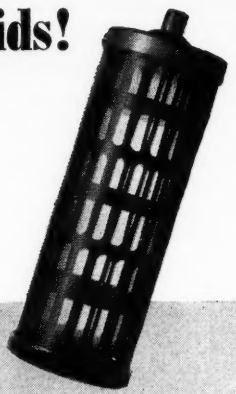
It had to resist corrosion—for the slightest corrosion would destroy the precision spacing of the gaps.

It had to be hard—so that edges of the thin ribbons would neither burr nor wear under the abrasion of a doctor blade with which some models are equipped to remove accumulated sludge.

By using Monel, all three demands—*and more*—were met!

Monel is corrosion-resistant . . . hard . . . workable. The ridged, tapered ribbons can be formed with no intermediate annealing. *(The next best material had to be annealed three times before reaching the final shape.)*

Thus, once again, Monel made a difficult job possible. Investigate Monel and all the INCO Nickel Alloys whenever *you* plan trouble-free operation in the equipment you design or buy. The International Nickel Company, Inc., 67 Wall St., New York 5, N. Y.



MONEL ELEMENTS INSURE EFFICIENT FILTRATION FOR POWER SYSTEMS

These new Purolator elements made of Monel are used for filtering water, gasoline, fuel oils and lubricating oils.

It's quite likely that one of the many types now available can protect your equipment from the trouble caused by scale, grit and sediment.

For detailed information on the important applications of these metallic ribbon filtering elements in the power field . . . for data which can help you improve performance, save cleaning time or cut maintenance costs, write Purolator Products, Inc., 744 Broad St., Newark, N. J.

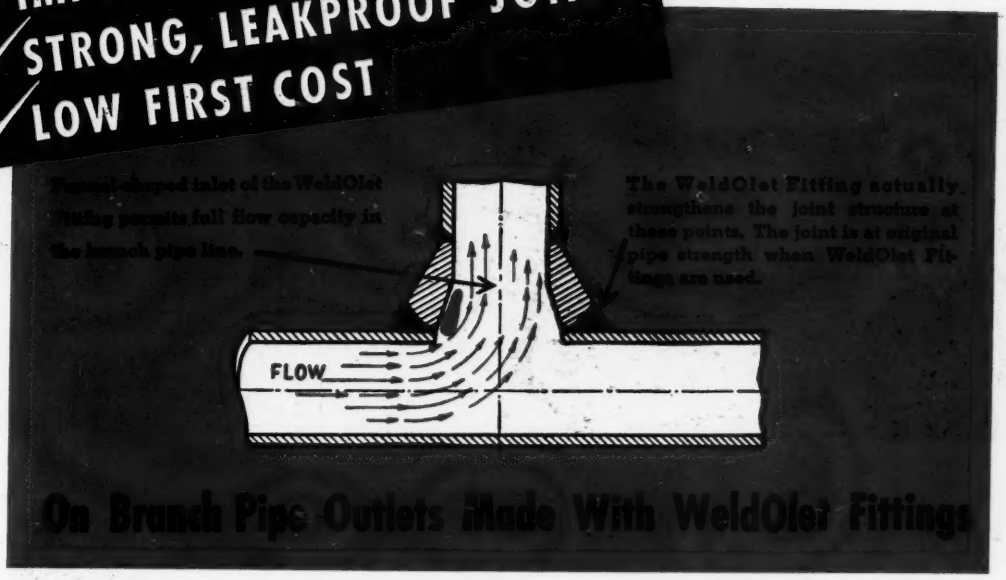
NICKEL INCO TRADE MARK **ALLOYS**

MONEL* • "K" MONEL* • "S" MONEL* • "R" MONEL* • "KR" MONEL* • INCONEL* • "Z" NICKEL* • NICKEL

Sheet...Strip...Rod...Tubing...Wire...Castings...Welding Rods (Gas and Electric)

*Reg. U. S. Pat. Off.

✓IMPROVED FLOW CONDITIONS
✓STRONG, LEAKPROOF JOINTS
✓LOW FIRST COST


Funnel-shaped inlet of the WeldOlet fitting permits full flow capacity in the branch pipe line.
The WeldOlet Fitting actually strengthens the joint structure at these points. The joint is at original pipe strength when WeldOlet Fittings are used.
FLOW

On Branch Pipe Outlets Made With WeldOlet Fittings

This cut-away drawing shows a WeldOlet Fitting in place. It shows how you can get improved flow conditions and strong, leakproof joints on branch pipe outlets.

Find out how these fittings can give you better branch pipe outlets at less cost. It is easy to install WeldOlet Fittings. No templates are needed. You don't have to waste time forming and fitting the run and branch pipes. Ask for a copy of the WeldOlet Catalog. It contains complete information on the uses, applications and installation of WeldOlet Fittings. It shows you how to save time and money and insure better flow conditions on your next branch pipe outlet job. Drop us a line today.

WeldOlet Fittings are stocked for all standard pipe sizes in size-to-size and reducing sizes with outlets from ¼" to 12". Available with beveled outlets and socket outlets for welding and with threaded outlets for screwed branch pipes.

BUY MORE WAR BONDS AND KEEP THEM

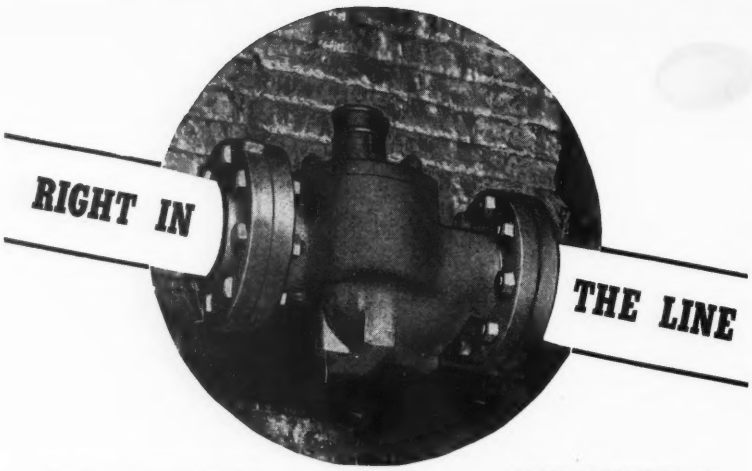
Forged Fittings Division • BONNEY FORGE & TOOL WORKS • 639 N. Meadow St., Allentown, Pa.

WELDOLETS

TRADE MARK REG. U. S. PAT. OFF. — PAT. IN U. S. & FOREIGN COUNTRIES

WELDING OUTLET - THREADED OUTLET - SOCKET OUTLET

For Welded Branch Pipe Outlets

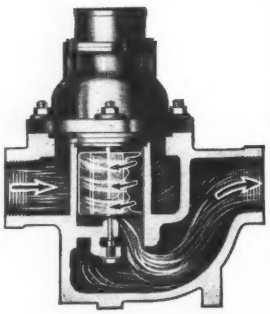


HENSZEY *Feed Water* METERS

can be installed right in the line without additional structural supports. Simplicity of installation, combined with extreme accuracy and rugged construction, make Henszey Meters ideal for the job of measuring Boiler Feed Water, Hot Dirty Blowdown, Condensate, Free Running Chemicals, and other "Hard-to-Measure" Liquids.

Henszey Meters are equally accurate at high or low flow — high or low pressures — on centrifugal or reciprocating pumps. Calibrations can be made to read in gallons, pounds or cubic feet at any specified temperature.

If you have a particularly tough job of measuring that demands accuracy — consider the Henszey Meter. Write for bulletin.



NO CLOSE CLEARANCES

Water enters the measuring chamber tangentially, spinning in the chamber as it passes through, forming a vortex. Each gallon that passes through this chamber makes the same number of revolutions of the water. A vane is placed in the rotating water to impart this rotation to the register. A minimum of working parts without close clearances.

HENSZEY COMPANY

DEPT. C-10 • WATERTOWN, WIS.

HENSZEY

FEED WATER METERS

Continuous Blowdown • Distillation Systems • Heat Exchangers
Flow Indicators • Boiler Feed Regulators • Proportioning Valves

possible seven complete changes of air each hour.

In view of the size of the equipment to be tested, there will be a 35 ft clearance under a 10 ton crane, operating on a 60 ft span, running the entire length of the building. Concrete roadways will connect the building to the main shop for convenience of transportation of equipment, and a railway siding will run into the building, making possible direct shipment of full-size gas turbine plants.

Among the permanent installations will be test stands for gas turbines, compressors and blowers, heat transfer equipment, a combustion laboratory a wind tunnel, a metallurgical laboratory, and an experimental machine shop.

Hewitt Acquires Robins Conveyors

HEWITT RUBBER CORP. of Buffalo, N. Y., recently announced that the company has acquired a controlling interest in Robins Conveyors, Inc., of Passaic, N. J. Hewitt has acquired approximately 90 per cent of the Robins Conveyors stock. This combination established Hewitt as a manufacturer able to engineer and build all parts of belt conveying systems under single management and responsibility.

Currently Hewitt and Robins are furnishing lengthy conveyors in this country and abroad, particularly Russia and South America. On the Norwegian Island of Spitzbergen, the company is rebuilding a large coal handling plant previously damaged by fighting between the Germans and British Commandos.

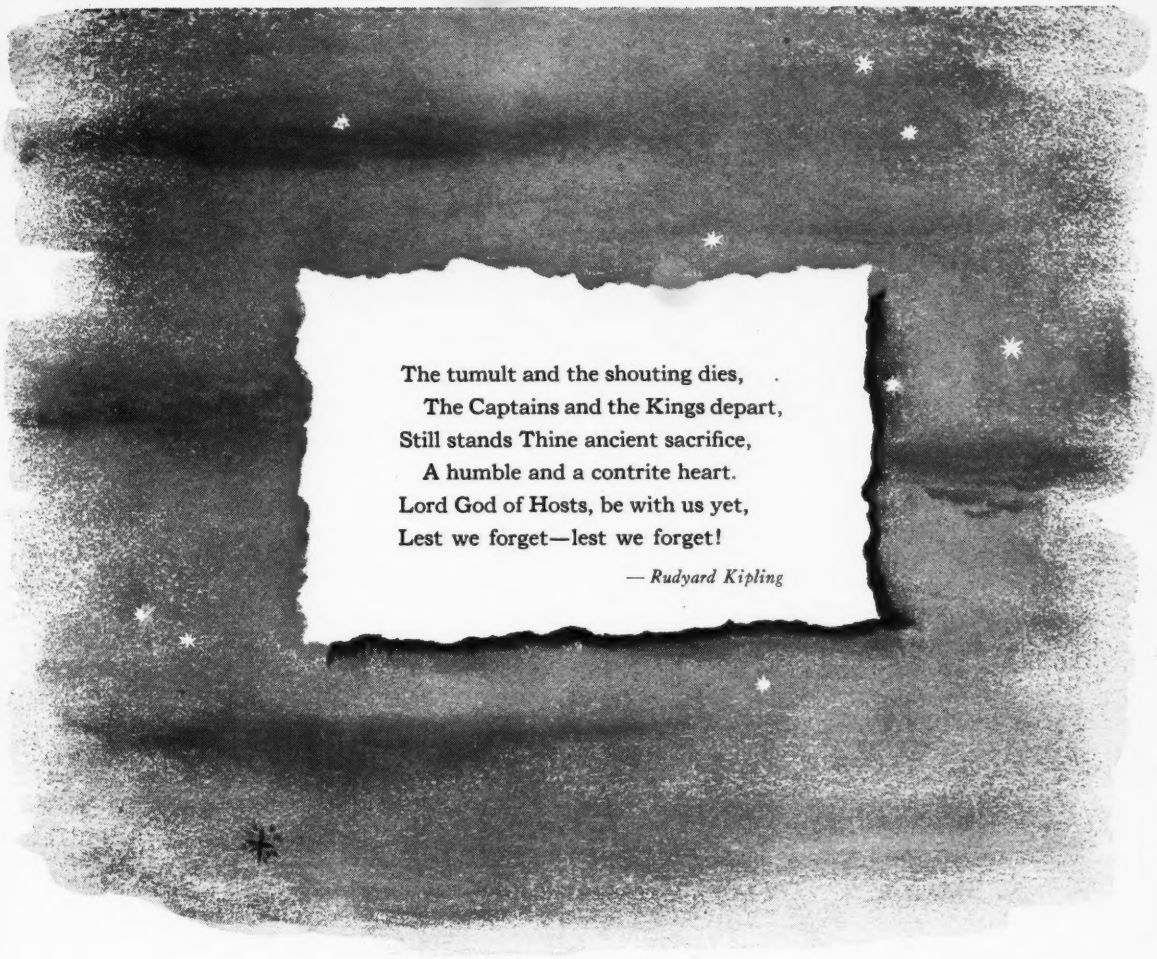
Hewitt anticipates sales in the immediate post-war years to be substantially greater than their pre-war level. During the war, Hewitt built many industrial rubber products for the manufacture of munitions and other war goods and was one of the leading manufacturers of bullet-sealing tanks for fighter planes. The company has just begun production of restfoam, its new latex from product for seat cushions and other upholstered items.

The Robins Conveyors subsidiary has no serious problem of reconversion at its Passaic, N. J., plant and already is engaged in the design and production of materials handling systems in demand for conversion of industry to a peace-time basis besides the reconstruction of war-damaged areas.

New Name for Hungerford Organization

DAN C. HUNGERFORD, president, announces that Aircraft Parts Development Corp., Summit, New Jersey, is changing its name to Hungerford Research Corp. This action is in line with a broadening of the organization's activity to cover product and process development in all fields of industry. Specialization will continue in the application of powder, metals and plastics to mechanical and electrical products.

Announcement is made also that the organization is moving to its new laboratory building in Murray Hill, N. J.


The tumult and the shouting dies,
The Captains and the Kings depart,
Still stands Thine ancient sacrifice,
A humble and a contrite heart.
Lord God of Hosts, be with us yet,
Lest we forget—lest we forget!
— Rudyard Kipling

To Our Customers and Friends—

You and we have worked together through four of the world's most tragic years. Our common interest in a common cause has strengthened old business friendships and has made many new ones. For this we are grateful.

This experience of mutual respect and confidence is *one* result of the war that will be carried over to the problems of peace. It is the very stuff that will assure profitable business at home and better relations with our neighbors abroad.

We of the Biddle Company fortunately have no factory problem of reconversion. For the most part, we make the same testing instruments for industry at peace as were required for war. And as more of our products become available for industrial and rehabilitation purposes, we will continue to serve you—in good faith always—and to the best of our ability.

JAMES G. BIDDLE CO.

1211-13 Arch Street, Philadelphia 7, Pa.

"MEGGER" INSULATION TESTERS, GROUND TESTERS AND OHMMETERS • "FRAHM" FREQUENCY METERS AND TACHOMETERS • "JAGABI" RHEOSTATS • INDICATING HAND TACHOMETERS • SCIENTIFIC APPARATUS

What YOU want in a Packing is HERE

STOP LEAKS with least friction

LONG SERVICE without frequent adjustment

NO SCORING of rod, shaft or stem

EASY SELECTION of correct packing for each purpose

PALMETTO Packings are made for every power plant and process apparatus . . . for every liquid, vapor and gas . . . for every service condition.

It's easy to choose and use the RIGHT packing from the simple PALMETTO line. Each type is designed to serve the widest possible range, and one package may be used for many different types of equipment.

You'll pack your pumps, compressors, engines, valves and other apparatus less frequently when you standardize on PALMETTO Packings. Convenient standardized packages available from our Distributors in all industrial centers. Write for descriptive literature.

PALMETTO

High-Pressure Folded Asbestos Gaskets

Asbestos Metallic Sheet Packing

Asbestos Metallic Gasket Tape

NOW AVAILABLE

GREENE, TWEED & COMPANY

Bronx Blvd. at 238th St., New York 66, N. Y.
Plants at New York, N. Y. and North Wales, Pa.

PALMETTO

PALMETTO for steam, water, air • PELRO for oils • CUTNO for alkalis • SUPER-CUTNO (blue asbestos) for acids. • KLERO for foods

Self-Lubricating **PACKINGS**

High Efficiency with New Gas-Diesel Engine

FROM MOUNT VERNON, OHIO, comes a report that a new world record in engine thermal efficiency, higher than anything ever attained before from any internal combustion or heat engine, including the widely publicized gas turbine, has been accomplished by a Cooper-Bessemer turbo-charged gas-Diesel engine.

Edmund Frederick, assistant chief engineer, claims the new record thermal efficiency is in excess of 40 per cent.

"This is higher than any thermal efficiency record ever accomplished by a steam, gas, gasoline, gas turbine or Diesel engine," Mr. Frederick said.

This new record was attained during routine tests on one of the company's regular Type JS engines, which carried all of its own auxiliaries.

The new gas-Diesel efficiency record follows by about six months the development of the new gas-Diesel engine by Cooper-Bessemer.

Trane to Expand Manufacturing Facilities

THE TRANE CO., La Crosse, Wis., has announced a postwar expansion program that will more than double its present manufacturing facilities.

A major part of the program consists of building a new addition to the main plant that will increase the size of that plant by 40 per cent. This will permit the fabrication of heating and air conditioning units on an assembly line basis. It will also provide greater facilities for the production of refrigeration and special heat transfer equipment. A second new building is being constructed on these premises to house factory office workers.

To further the expansion, the company has purchased the large factory building which it leased during the war for the production of heat exchange equipment for airplanes. After extensive remodeling and new construction this area will be used for the production of heating specialties.

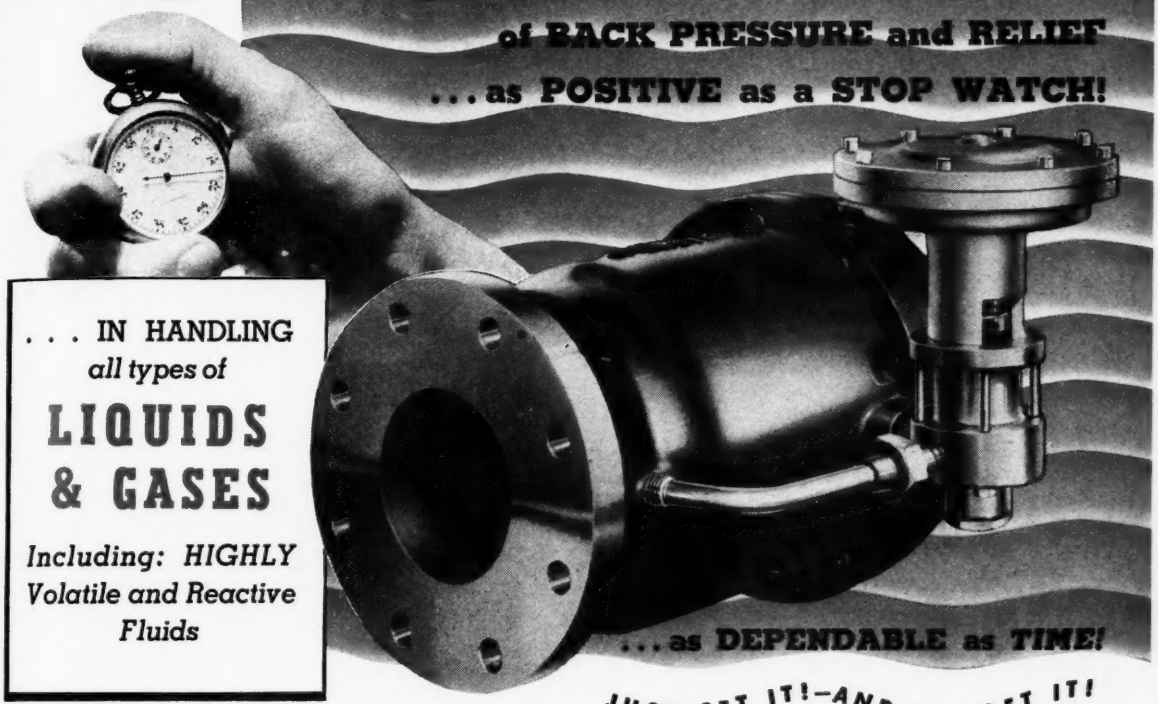
It is anticipated that this expansion will call for the employment of approximately twice as many workers as the company employed during peak pre-war years. Additional branch offices are being set up throughout the country and the staffs of the 86 offices now operating will be increased. More active participation in world-wide markets is expected. An export department has been set up which will establish sales connections throughout the world.

Wylie Brown, president of Phelps Dodge Copper Products Corp. has announced that grading has begun on a site at Fort Wayne, Ind., where the copper company will erect a $4,500,000 rod, wire and cable plant to operate as a new and separate division, not as an addition to the magnet wire and coil plant of Inca Division. It will be fully equipped for copper rod rolling and for wire drawing, stranding and insulating on a tonnage basis. The new plant will occupy about 31 acres and, when in full production, will employ several thousand persons.

Absolute BUBBLE-TIGHT Leak-Proof Control

of BACK PRESSURE and RELIEF

... as POSITIVE as a STOP WATCH!



... IN HANDLING
all types of
LIQUIDS & GASES
Including: HIGHLY Volatile and Reactive Fluids

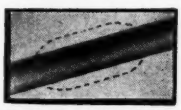
... as DEPENDABLE as TIME!

JUST SET IT!—AND FORGET IT!

Extremely Sensitive to Slightest Fluctuation in Pressure

HYDRAULICALLY & PNEUMATICALLY SELF-OPERATED

EXPANDS TO OPEN



CONTRACTS TO CLOSE

A stop-watch that lets even a single second slip by — once it is "clicked" off, would be absolutely unreliable. So, too, in the control of pressures, shut-off must be positive and leak-proof — to avoid hazards and failure, especially where corrosive and inflammable liquids or gases are concerned. With the Grove Flexflo *automatic self-operating* Back Pressure Regulator or Relief Valve, there is never the slightest seepage or external leakage of even the most highly volatile or severely reactive fluids. Extreme sensitivity makes this self-contained valve instantly responsive to the slightest fluctuation in pressure. Just set it — then forget it. These valves are designed for pressures ranging from 200 lbs. to 2500 lbs.

Write today for complete details.

GROVE *Automatic... Self-Operating* FLEX-FLO

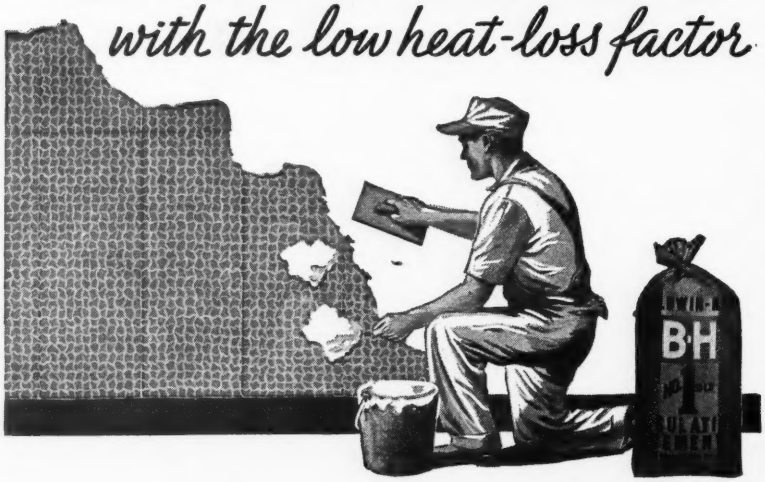
BACK PRESSURE REGULATOR - OR RELIEF VALVE

GROVE REGULATOR COMPANY

6491 GREEN STREET, OAKLAND 8, CALIFORNIA • *Branch Offices:* 30 Rockefeller Plaza, New York 20 • 5644 Navigation Boulevard, Houston 11, Texas • 1930 West Olympic Boulevard, Los Angeles 6, California

B-H No. 1 *insulating* CEMENT

with the low heat-loss factor



Write your own specifications for the perfect insulating cement. Then compare them with the actual performance of B-H No. 1 Cement. You will find that *this* cement measures up.

Its heat-loss factor is singularly low. A 3-inch application will reduce a surface temperature of 800° F., for instance, to 158° F.—cutting the heat loss to only 150 b.t.u. per sq. ft. per hour. It can do this because its basis is *black* Rockwool, high in resistance to both heat and moisture; it does not disintegrate.

Even under the most humid conditions, B-H No. 1 Cement retains its high insulating values and at the same time protects the surfaces it covers. ***A special rust-inhibitor*** safeguards metal against corrosion and assures a permanent bond.

B-H No. 1 Cement resists any temperature up to 1800° F. and is completely reclaimable up to 1200° F. Easily applied to the most irregular surface, it is the *practical* answer for all maintenance work.

The coupon below will bring you full information and a working sample of B-H No. 1 Cement.

Baldwin-Hill

SPECIALISTS IN THERMAL INSULATION PRODUCTS

Baldwin-Hill Co., 528 Klagg Ave., Trenton 2, N. J.

Send information on products checked below:

- ☐ Free sample of B-H No. 1 Cement
- ☐ No. 100 Pipe Covering—effective up to 1200° F. (for long runs overhead, underground, Diesel exhausts)
- ☐ Mono-Block—the one-block insulation for all temperatures up to 1700° F.
- ☐ Black Rockwool Blankets (felted between various types of metal fabrics)

NAME _____ POSITION _____

FIRM _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

Corning Glass Works has announced the establishment of a public relations department and the appointment of Thomas F. Robertson as manager of public relations. The department will have headquarters at the company's home offices in Corning, N. Y., and will be responsible for the handling of news, institutional advertising, publicity, internal and external publications, and other activities concerned with the company's relations with the public.

Roots-Connersville Blower Corp. is making extensive improvements in its offices at the plant in Connersville, Ind. This addition provides six additional offices, a conference room, and a drafting room. It is planned to modernize the rest of the offices by installing an up-to-date heating and ventilating system throughout. Rest rooms are being enlarged and modernized, and it is hoped to have the work completed this year.

National Tube Co., U. S. Steel subsidiary, has announced that it has established a new basing point at Chicago, Ill., effective immediately to apply to its Price Schedule M covering USS stainless steel seamless tubing for mechanical and pressure purposes for the range of sizes and finishes produced by it in the Chicago area. Pittsburgh, Pa., will continue to be a basing point for similar products. The basing point prices at both points will be the same and all prices are subject to OPA price ceilings.

A new addition to its factory at 340 N. Sacramento Boulevard, has just been completed by Rempe Co., for the manufacture of the new post-war line of unit blowers for air conditioning and refrigeration and fin coils for low temperature cooling. The new blower line is being made in a large range of sizes and for use with all types of refrigerants including prestone and brine. Fin coils for temperatures as low as 40 F. are manufactured for quick freezing of perishable products.

W. A. Charbonneaux's interest in the Burlington Instrument Co., 214½ North Fourth Street, Burlington, Iowa, has been purchased by the remaining partners and he is no longer associated with the Company which will continue in business as heretofore under the ownership and management of the remaining partners, Walker D. Hanna, Alfred K. Kramer, and Wilbur S. Kramer.

A new sales office has been established by Page Steel and Wire Division of American Chain & Cable Co. Inc., in the General Motors Building, Detroit, Mich. E. B. Brant and W. R. Stephens, formerly at the Page plant at Monessen, Pa., will make their headquarters in the Detroit office.

Pipe & Tube Products Inc. of Jersey City and Reading, Pennsylvania, has moved its executive and sales offices from Jersey City to the Empire State Building in New York City. The company's brass and copper pipe and tube mill has entered full production at Reading, Pa.

Crystolon Brick FOR

CRYSTOLON Brick by Norton will give long, economical service at top capacity and will reduce maintenance time and expense when used at the clinker line of coal-fired boiler furnaces, in the bridge wall and front wall. These highly refractory silicon carbide brick have great resistance to abrasion, to spalling and to the chemical and physical action of molten slag. Slag may adhere to the brick to a very limited degree, but it is easily removed without harming the surface of the wall.

NORTON COMPANY - Worcester 6, Mass.

Norton Longer Lasting Refractories

How To Give Stuffing Boxes
THE "BELMONT CURE"

FIRST STEP is to check pumps and engines for signs of leaking valves, pistons, rods and plungers.

THIRD STEP is to have a supply of standard Belmont Packings on hand so as to stop the leak at once with a packing that will do the job best and for the longest time.

SECOND STEP is to refer to Belmont PACKING RECOMMENDATION CHARTS which quickly identify the right packing type for each set of operating conditions.

BELMONT DISTRIBUTORS are located in every large industrial center, ready to serve you promptly from local stocks. Get the PACKING RECOMMENDATION CHARTS from the one nearest you — or send the coupon to us.

THE BELMONT PACKING & RUBBER CO. — BELMONT — PHILADELPHIA, U.S.A.

on the blue-and-orange box

THE BELMONT PACKING AND RUBBER COMPANY
Butler & Sepviva Streets, Philadelphia 37, Pa.

Gentlemen: Please send PACKING RECOMMENDATION CHARTS for the services checked:

☐Steam . . . ☐Hot Water . . . ☐Cold Water . . . ☐Brine . . . ☐Ammonia . . .
☐ Acids & Caustics . . . ☐ Air . . . ☐ Gas . . . ☐ Oil . . . ☐ Gasoline . . .
☐ Asphaltic & Tar Products . . .

Name .....
Company .....
Address .....

Announcement has been made that Bowser, Inc., has acquired another wholly owned subsidiary in furthering of its post-war expansion program with the purchase of the Peterborough Lock Mfg. Co., Ltd., Canada. This action will enable the Bowser industries to make a much deeper penetration of the Canadian market to meet post-war competition. The lock company manufactures a complete line of hardware products.

MANUFACTURERS' *Personals*

C. D. Carter, division sales manager of the southern division of the Iron Fireman Manufacturing Co. in Atlanta, Ga., has been promoted to manager of the central division with headquarters in Cleveland, Ohio. Carter is being succeeded by S. W. Alford.

Charles H. Rhodes, Chicago vice president of United States Steel Corp. of Delaware, retired September 1, having reached the corporation's retirement age. Mr. Rhodes has been associated with the corporation and subsidiary companies in various important capacities since his initial employment with the American Steel & Wire Co. in May, 1899. He will reside in Southern California where for many years he has had a home and business interests.

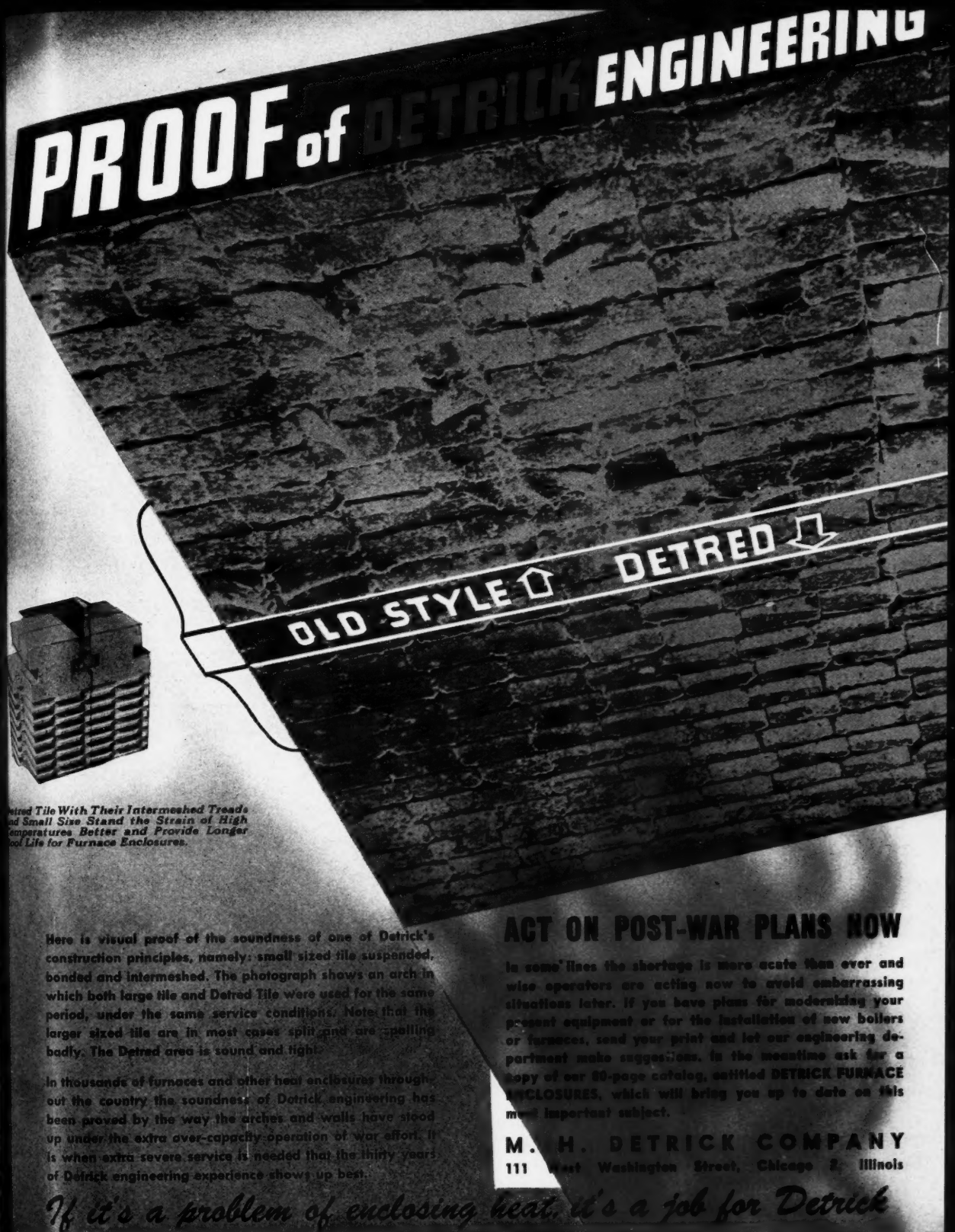
Henry I. Guy, assistant manager of the transportation divisions at General Electric's Erie Works, retired August 1, 1945, after more than 40 years of service with the company. Following his graduation from Virginia Polytechnic Institute in 1904, Mr. Guy entered G-E Test at Schenectady in 1905, and in 1906 he transferred to what was then the foreign department as an engineering assistant. In 1939 he was appointed assistant manager of the transportation divisions; a position he held until his retirement. F. H. Craton will assume Mr. Guy's responsibilities as assistant manager.

Diesel Equipment Co., 308 South 2nd Street, Memphis, Tenn., has been appointed Distributor for Briggs Clarifier Co. of Washington, D. C. The territory assigned includes Western Tennessee and Northeastern Arkansas and portions of Southeastern Missouri, Southern Illinois, Southern Indiana and Southern Kentucky. Worthington Brown and William F. Fay who jointly own and manage the firm have had many years experience in the distribution and servicing of industrial products.

Lewis A. Harlow, who recently took over the post of manager of the advertising division of Fairbanks, Morse & Co., began training for the position at the early age of fourteen when he was editor, typesetter, and printer of his class paper at Milton Academy. Later, still pursuing the course he seemed destined to follow, he was made editor of the school paper in 1919—his last year. From Milton Academy Mr. Harlow entered

PROOF of DETRICK ENGINEERING

Detred Tile With Their Intermeshed Treads and Small Size Stand the Strain of High Temperatures Better and Provide Longer Roof Life for Furnace Enclosures.



Here is visual proof of the soundness of one of Detrick's construction principles, namely: small sized tile suspended, bonded and intermeshed. The photograph shows an arch in which both large tile and Detred Tile were used for the same period, under the same service conditions. Note that the larger sized tile are in most cases split and are spalling badly. The Detred area is sound and tight.

In thousands of furnaces and other heat enclosures throughout the country the soundness of Detrick engineering has been proved by the way the arches and walls have stood up under the extra over-capacity operation of war effort. It is when extra severe service is needed that the thirty years of Detrick engineering experience shows up best.

ACT ON POST-WAR PLANS NOW

In some lines the shortage is more acute than ever and wise operators are acting now to avoid embarrassing situations later. If you have plans for modernizing your present equipment or for the installation of new boilers or furnaces, send your print and let our engineering department make suggestions. In the meantime ask for a copy of our 60-page catalog, entitled DETRICK FURNACE ENCLOSURES, which will bring you up to date on this most important subject.

M. H. DETRICK COMPANY
111 West Washington Street, Chicago 2, Illinois

If it's a problem of enclosing heat, it's a job for Detrick

DETRICK FURNACE ENCLOSURES

USE DETRICK INSULATION . . . PLASTIC or BLOCK

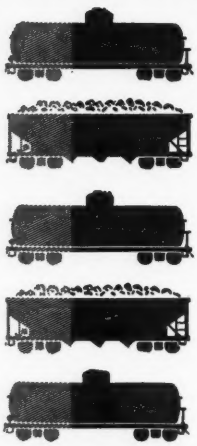
A Fuel Saving Method THAT IS

SIMPLE AND DEPENDABLE

Of all the plans, products and methods advocated as fuel-savers, Enco Streamline Baffles represent one of the simplest and most dependable means available.

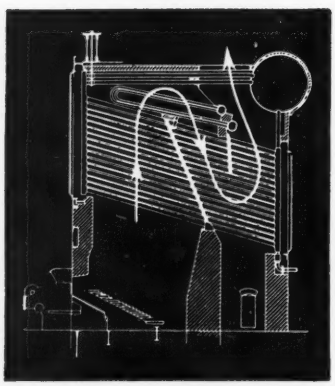
They are easily put to work because they are adaptable to any type of water-tube boiler—and the entire job can be turned over to this company.

Dependable because they are designed on sound engineering principles, backed by The Engineer Company's quarter-century of experience in this field. Baffles are individually designed to meet the requirements of each boiler. Installations are made by our mechanics whose skill in this work is unsurpassed.



A Booklet Worth Having

Details of these baffles, with descriptions of novel and ingenious constructions used in numerous types of boilers are available in this booklet. It is looked upon by many engineers as a reference book of real value. Your copy will be sent on request.



THE ENGINEER COMPANY

75 WEST STREET • NEW YORK 6, N. Y.

Canada: F. J. Raskin, Inc. • 370 Rachel E., Montreal, P. Q.

Enco Streamline Baffles

PRODUCED EXCLUSIVELY BY THE ENGINEER COMPANY

Harvard University and graduated with honors in 1922. In 1943 he joined Fairbanks-Morse as Assistant Advertising Manager; and, until his recent advancement to the position of Manager, helped supervise the many and varied advertising activities of the company.

Lloyd A. Russ has been appointed manager of the Agency and Specialties Department by Westinghouse Electric Corp. A native of Minneapolis, Minn., Mr. Russ attended the University of Minnesota there, receiving his bachelor of science degree in electrical engineering in 1929. Joining Westinghouse the same year, and since 1941, he has been manager of the distribution apparatus section of the agency and Specialties Department at East Pittsburgh. Mr. Russ succeeds W. D. Turbull who resigned.

Portable Products Corp. has announced the appointment of E. D. Wacker as general manager of its C. J. Tagliabue division, Brooklyn, N. Y. Mr. Wacker for the last eight years has been General Sales Manager, and associated with C. J. Tagliabue for a period of twenty-two years.

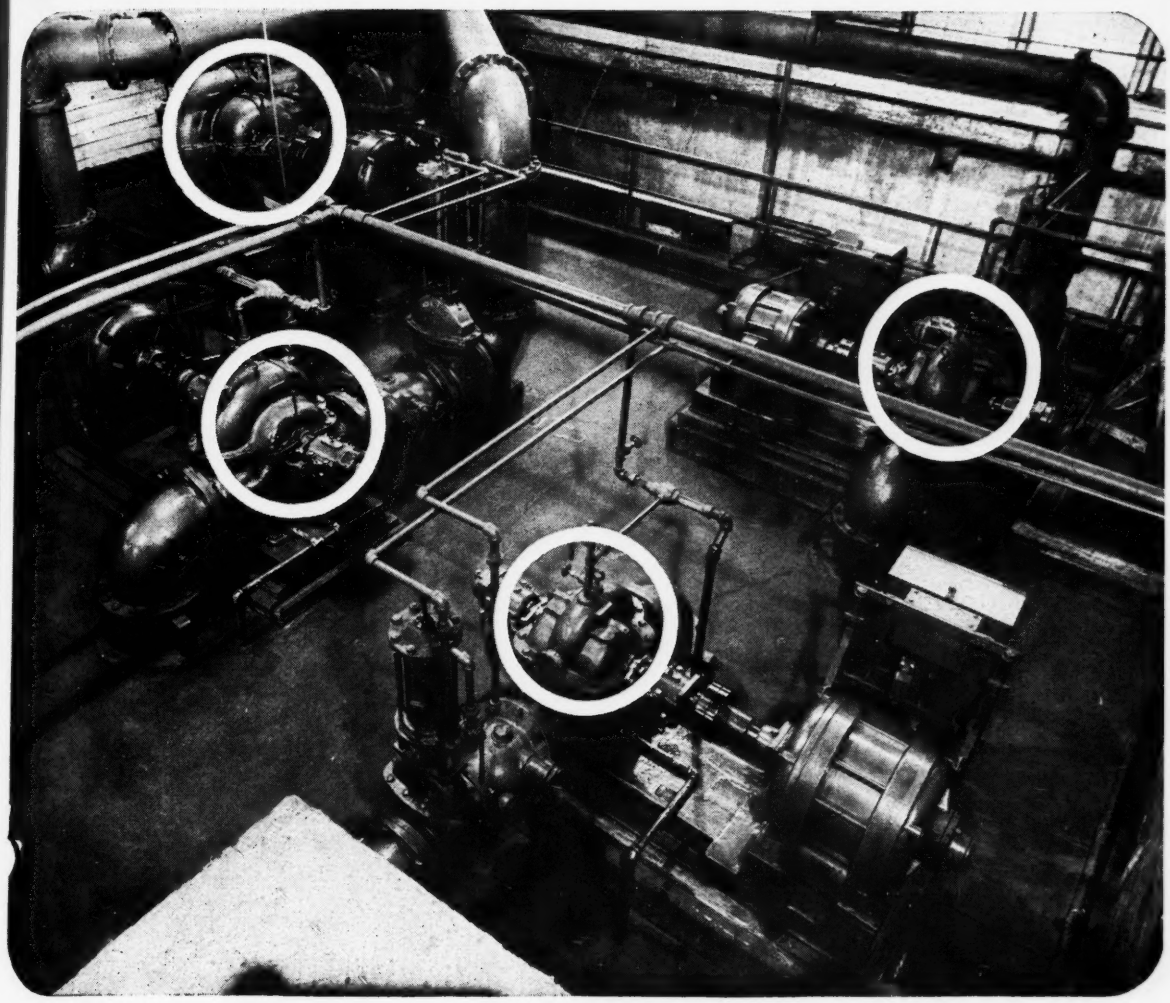
The appointments of Carl A. Ilgenfritz as vice president in charge of purchases of Carnegie-Illinois Steel Corporation, a newly established management responsibility and R. L. Van Cleve as general purchasing agent of the company have been announced. Their offices will be located at 434 Fifth Avenue, Pittsburgh.

Carnegie-Illinois Steel Corp., United States Steel subsidiary, has announced the following appointments: Heber V. Lauer becomes field supervisor, raw materials, fuel and power division, Chicago district. Jack H. Eisaman is appointed superintendent, number 2 electric furnace shop, South Chicago Works, Carnegie-Illinois Steel Corporation.

The appointment of A. C. Monteith as assistant manager of headquarters engineering has been announced by the Westinghouse Electric Corp.

Mr. Monteith has been manager of the industry engineering department since 1941, and now will direct headquarters engineering activities in the absence of C. A. Powel, assigned to the military government of Germany with responsibility for establishing the control of electrical and radio manufacturing in that country. Also in the capacity of director of education, Mr. Monteith assumes over-all responsibilities for student recruitment and training, university relations including university visitation, scholarships, fellowships and professorships. These activities will be directly supervised by Charles W. MacLean, whose appointment as manager of the educational department has been announced.

Rowland B. Drescher has been appointed manager of the Pittsburgh district, for the Republic Flow Meters Co., with offices in the Investment Building. He succeeds Carl E. Pritchett who died on April 12th after managing this district for twenty-three years.



LARGE WOOLEN MANUFACTURER

Relies on Warren Pumps in its Filter Plant...

Shown above is part of one of the largest rapid sand filter installations in New England. It was installed by Hungerford & Terry, Inc., in a well-known woolen manufacturing plant.

The company operates more than 750 looms at this mill, and Warren pumps are relied upon to handle between 42 and 82 million gallons of water per week.

Write for complete information on Warren Pumps for textile and other mill installations.

ARMY E NAVY

WARREN PUMPS

WARREN STEAM PUMP COMPANY, INC.

WARREN, MASSACHUSETTS

FULLY AUTOMATIC
ROD PACKING SHOWS UP TO
300% LONGER LIFE

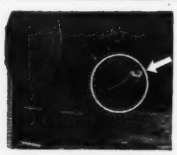
CHESTERTON Parachute Packing

Your best packing bet on high pressure pumps, steam engines, hydraulic rams, and air compressors—also for use with hot or cold oils, gasoline, and solvents—is CHESTERTON Parachute. . . . It is fully automatic, moulded in construction, *needs no bothersome after adjustments,* holds a tight seal, cuts plant maintenance. Many engineers say this automatic packing shows up to 300% longer working life. Try it on your next job.

WRITE FOR *FREE* 72-PAGE PACKING HANDBOOK

A. W. CHESTERTON CO.
64 INDIA STREET • BOSTON, MASS.
DISTRIBUTORS IN PRINCIPAL CITIES

"Boiler Repairs Reduced 75%"
writes user of NATIONAL GIRTH SEAM PROTECTOR



We have been using the National Girth Seam Protector for several years and they certainly do the job. . . . Have reduced our boiler repairs at least 75% since using these protectors, one of the best investments we ever made.
Von Platen-Fox Co.
Iron Mountain, Mich.

You, too, will find the National Girth Seam Protector saves trouble and money by preventing leaks and fire-cracking on new or old seams in boilers. Sections consist of wedge nut, cap screw metal lug and refractory covering; are easily attached. We can make immediate deliveries. Send for descriptive bulletin.

NATIONAL BOILER PROTECTOR CO., 740 REIBOLD BLDG., DAYTON, OHIO

Harry G. Howell is the new vice president of Tube Turns, Inc., Louisville, Ky., in charge of production. He has had a total of twenty-two years' association with General Motors, the last four of which have been as head of Oldsmobile's plant.

H. J. French has resigned as assistant director for raw materials and facilities of the steel division, War Production Board, at Washington, D. C., and has resumed his duties as assistant manager of the development and research division of The International Nickel Co. Inc., at New York.

The appointment of W. E. Dueringer as assistant sales manager and H. E. Weaver as proposition department manager has been announced by Bailey Meter Co., Cleveland 10, Ohio. Both Mr. Dueringer, who is a graduate of the University of Illinois, and Mr. Weaver, who is a graduate of Johns Hopkins University, have been associated with Bailey Meter Co. for over 25 years in various engineering and sales capacities. During this time they have solved successfully many difficult problems in the application of metering and control equipment. Their combined experience covers a wide range of steam power plans and process industries.

The Edward Valve & Mfg. Co., Inc., East Chicago, Ind., has appointed Leatherman & Mertz as its representatives for all of Michigan, excluding the upper peninsula. The firm of Leatherman & Mertz is headed by Lloyd R. Leatherman and Charles M. Mertz. Offices are in the Book Building, Detroit 26, Michigan.

Klau-Van Pietersom-Dunlap Associates Inc., Milwaukee advertising agency, has just announced the election of George J. Callos as vice president and account executive. Mr. Callos was formerly advertising and public relations manager of Allis-Chalmers Manufacturing Co., and last year was chosen by a national group of advertising men as the nation's industrial advertising man of 1944.

William C. Van Cleaf has been appointed director of industrial relations for the Allis-Chalmers Mfg. Co. Prior to his appointment, Van Cleaf served as assistant to Lee H. Hill, former head of industrial relations who has resigned.

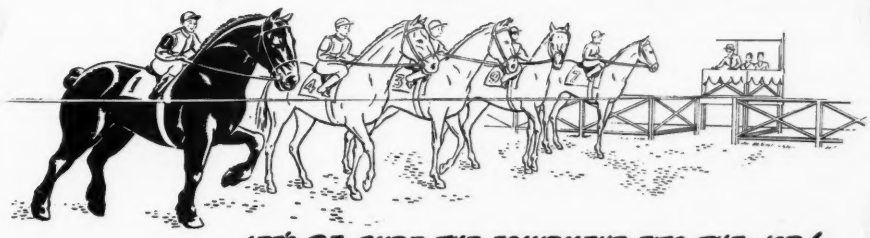
American Steel and Wire Co., United States Steel Corp. subsidiary, has promoted H. A. Squibbs, formerly assistant general manager of sales in Chicago, to assistant to sales vice president, and C. T. Gilchrist has been promoted to succeed him.

After three years as a Major in the Production Division, ASF in Washington, E. K. Stevens has returned to his position as Associate Manager of the National Exposition of Power & Mechanical Engineering.

Two changes in the sales executive organization of Fairbanks, Morse & Co. have just been announced. The new acting manager of the railroad division is John S. King, formerly

FOR ASSURED VALVE PERFORMANCE

consult Powell Engineering first



LET'S BE SURE THE EQUIPMENT FITS THE JOB!

Everyone knows it would be silly to enter a Draught Horse in a race. On the other hand, a Thoroughbred wouldn't last long pulling a heavy load. But unless you're an expert valve engineer, it's not so simple to determine what type, design and material a valve should be to do a specific job. Powell Engineering, with a background of almost a century of research, experimentation, and practical experience, will be glad to assist you in selecting the correct valves to meet your particular flow control requirements.

The Wm. Powell Co., Cincinnati 22, Ohio

DISTRIBUTORS IN PRINCIPAL CITIES

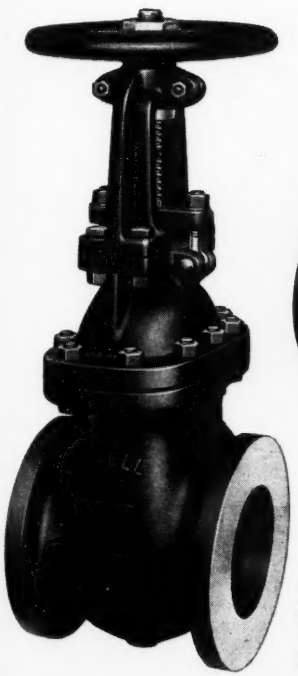


Fig. 1793—Iron Body Bronze Mounted Gate Valve for 125 pounds W.S.P. Has flanged ends, outside screw rising stem, bolted flanged yoke and taper wedge solid disc. Also available with taper wedge double disc—Fig. 1444.

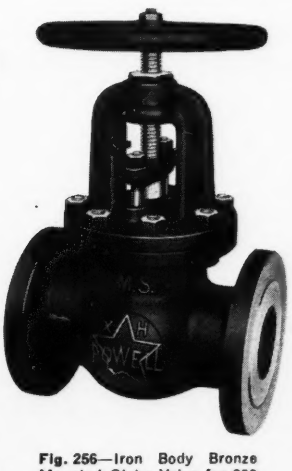


Fig. 256—Iron Body Bronze Mounted Globe Valve for 250 pounds W.S.P. Has flanged ends, outside screw rising stem, bolted flanged yoke, and regrindable, renewable bronze seat and disc.

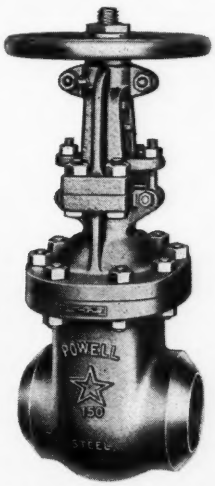


Fig. 1503 WE — Class 150-pound Cast Steel Gate Valve, with welding ends, outside screw rising stem, bolted flanged yoke and taper solid wedge.

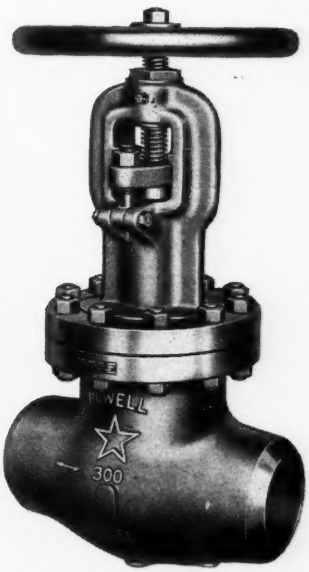


Fig. 3031 WE—Class 300-pound Cast Steel Globe Valve, with welding ends, outside screw rising stem and bolted flanged yoke.

POWELL VALVES

if your GAUGE GLASS NEEDS ARE WIDELY VARIED

An important factor in the service life of any gauge glass is the selection of the right glass for a specific purpose. From four different types of gauge glasses in the CORNING and PYREX complete line, you can select the one best suited to your service requirements.

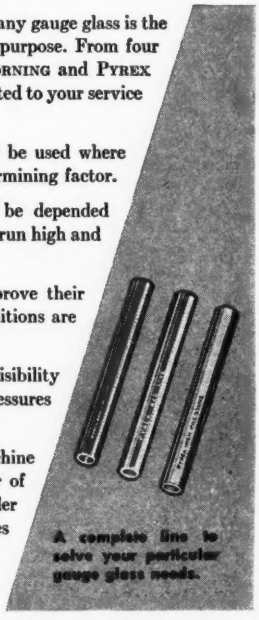
1. CORNING Standard Gauge Glasses should be used where pressures are moderate and low cost is a determining factor.

2. PYREX High Pressure Gauge Glasses can be depended upon to give outstanding service where pressures run high and over-all economy means more than initial cost.

3. PYREX Broad Red Line Gauge Glasses will prove their value for high pressure service where lighting conditions are poor and maximum visibility is demanded.

4. PYREX Red Line Gauge Glasses offer greater visibility than that of a plain gauge glass for services where pressures are high.

Because all of these gauge glasses are made with machine drawn accuracy, they are easy to install without danger of breakage from installation strain. They will stand up under severe service conditions when they are used for the pressures for which they are recommended.



A complete line to solve your particular gauge glass needs.

"PYREX" and "CORNING" are registered trade-marks and indicate manufacture by Corning Glass Works, Corning, N. Y.

CORNING Glass Works Corning, New York

Corning Gauge Glasses

TEMPLETON RETURN STEAM TRAPS

for Pumping, Boiler Feeding, Draining, Heating and Vacuum Lines

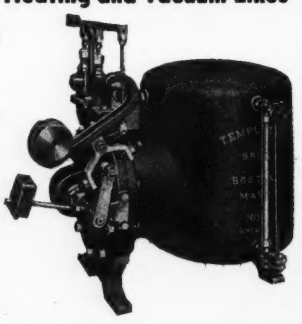
Pumps Water at any temperature or pressure.

Open float cannot burst or waterlog.

Valves and Seat Bronze or Stainless Steel.

Sizes 1 in. to 4 in. inlet and outlet.

Capacity 2500 lbs. to 60,000 lbs. water discharge per hr.



Ask for catalogue and prices

TEMPLETON BROS., INC.

699 Main St. Walpole, Mass.

manager of the company's pump division. He succeeds C. H. Wilson, who is on an extended leave of absence due to his health. Arnold G. Brown, formerly assistant manager of the pump division, succeeds Mr. King as manager of that division.

The Osborn Manufacturing Co., of Cleveland, has appointed Robert H. Boyer as sales engineer. Mr. Boyer will assist Osborn salesmen in studies of the application and use of power brushes.

Sterling Engine Co., Buffalo, has just announced the election of Lewis G. Harriman, president of The Manufacturers and Traders Trust Co. of Buffalo to its Board of Directors.

NEWS *from* THE FIELD

Wood Pole Specifications

THE AMERICAN STANDARDS ASSOCIATION has been requested by the government to use its emergency procedure in developing specifications for wood poles made from jack pine, red pine, western white pine, inland types of douglas fir, western hemlock, western larch, and certain other miscellaneous species.

Prime purpose of this job will be to conserve our natural timber supply; and secondly to channel the production and use of poles so that all purchasers will have a fair share of the available timbers.

During the war years use of poles has been cut in half by war-time restrictions, leaving a big pent up demand for poles that will hit the market now that the restrictions have been removed. Based on statistical information appearing in the proceedings of the American Wood-Preservers' Association this potential demand for poles is likely to run to at least four million poles a year during the next few years. As a result of this situation conservation of our timber supply is not only advisable but imperative, if all pole users are going to get the products they need.

As a further conservation measure the specifications will aim at treatment of every pole with wood preservatives so that poles will last as long as possible. The specifications will, of course, also cover prohibited and permitted defects, such as sap stain, twist grain, insect damage, knots, scars, etc. Such matters as manufacturing requirements, dimensions, storage, and handling will also be covered.

ASHVE Begins Health Research

ON OCTOBER 1, Allen D. Brandt, Sc.D., Senior Sanitary Engineer, U. S. Public Health Service, commenced his duties at the ASHVE Research Laboratory to conduct studies involving the relationship of air condition-

"LOW STEAM CONSUMPTION MAINTAINED"

reports the city of Corbin, Ky., of their 1500 KW Worthington-Moore Turbine Generator.

GEO. W. JENKINS
Commissioner of Finance

BERT ROWLAND, Mayor

Power and Water Department
CITY OF CORBIN
H. C. CRAFT, Superintendent
Corbin, Kentucky

JOHN V. WALKER
Commissioner of Public Works

Worthington Pump and Machinery Corporation
Eight and Race Streets
Cincinnati 1, Ohio

Dear Sir:

Attention-Mr Earle W. Vinnedge
Manager
Cincinnati District Office

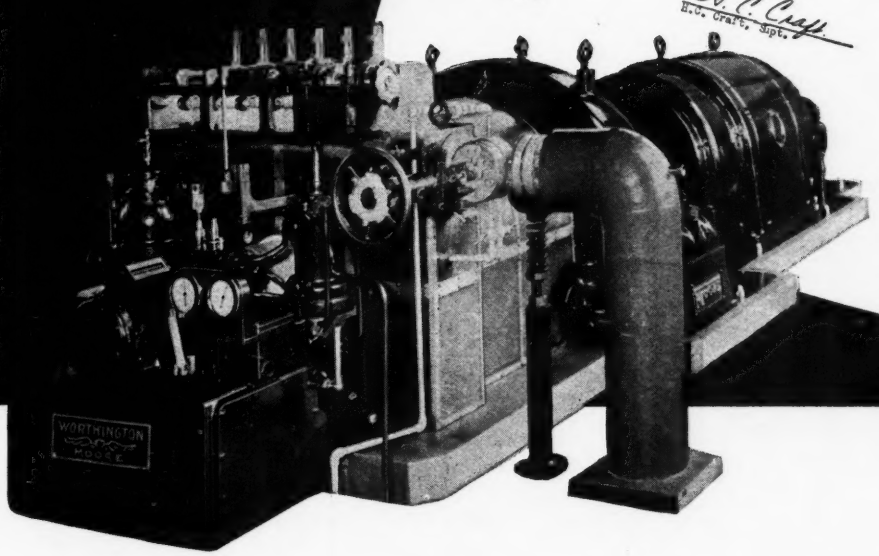
You will recall that when our 1500 KW turbine generator unit which we purchased from Worthington was installed 4½ years ago it was necessary for us to immediately put it in service due to load demands without the usual tune up period. Since then the unit has been in practically continuous service and now that we are in a position to do so we have decided to open the turbine for inspection.

We believe that you will be interested to know that except for routine adjustments maintenance has been negligible and the original low steam consumption has been maintained. We are very pleased with the service and economical operation this unit has given us and the interest you have shown.

Yours very truly,
CITY OF CORBIN
POWER and WATER DEPT.

MP/hcc

H. C. Craft
H.C. Craft, Supt.

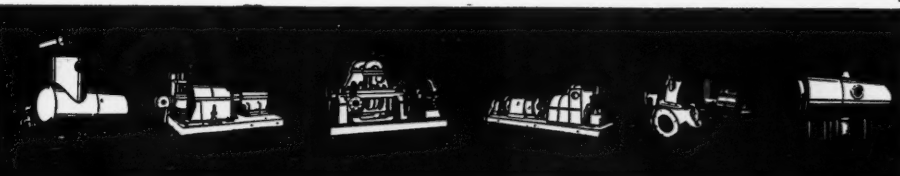


Low maintained steam consumption, freedom from operating troubles and the ability to be placed in continuous service immediately after erection without a "tune-up" period are typical characteristics of all Worthington Turbine Generator units. This is made possible by our practice of testing the complete unit under operating steam conditions and load at our works before shipment . . . Write today for Bulletin 1960 . . . further proof that *there's more worth in Worthington. Worthington Pump and Machinery Corporation*, Moore Steam Turbine Division, Wellsville, N. Y.

WORTHINGTON

T5-2

A GREAT TEAM IN STEAM



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ing and ventilation to industrial hygiene.

His assignment was authorized by the U. S. Public Health Service and is welcomed by the Committee on Research of the American Society of Heating and Ventilating Engineers.

Dr. Brandt is a native of Pennsylvania, was graduated from Penn State College in 1931, and received the Rockefeller Foundation Fellowship for advanced work in Industrial Hygiene at Harvard University, where he studied under Professors Philip Drinker and C. P. Yaglou. His research and thesis for the Doctorate degree were in the field of air conditioning and health.

From 1933 to 1940 Dr. Brandt was director of the Industrial Hygiene Research and Development Laboratory of Willson Products, Inc., at Reading, Pa. In 1940 he went into public health service work, and has been responsible for the overall supervision of the engineering phases of the industrial hygiene program in about 90 Army-owned plants employing over 475,000 workers manufacturing, loading, and storing explosives. In this capacity he assisted greatly in the design of adequate ventilating systems for the control of atmospheric health hazards affecting thousands of workers, and contributed substantially to the splendid health record made by the Army Ordnance Department.

Research Laboratories for Standard Oil

CONSTRUCTION OF new research laboratories for Standard Oil Co. (Indiana) has been started on property recently purchased by the company in Hammond, Ind., near the Whiting refinery, with which it will be connected by pipe lines.

Standard will proceed at once with erection of the main administration building, general laboratories, and three pilot-plant buildings. An engine laboratory, a greenhouse for insecticide work, additional pilot-plant buildings, and other research facilities are scheduled for subsequent construction.

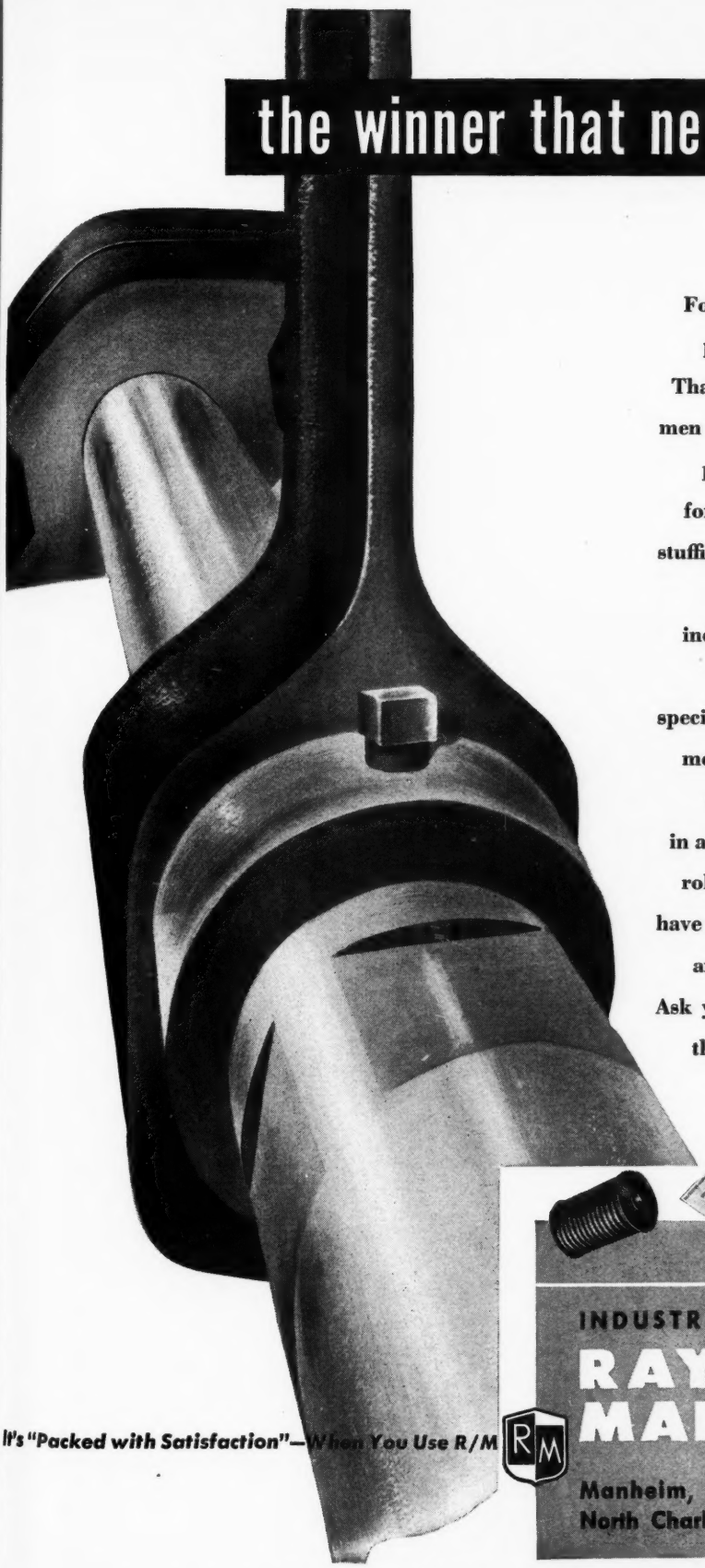
The principal buildings in the group will be of light-gray brick, in the modern type of architecture. They will be air conditioned throughout and lighted in accordance with the best modern practice.

Architects of the project are Holabird & Root of Chicago.

Two hundred of the company's technologists and 260 other research workers are at present housed in old and somewhat cramped quarters scattered through the Whiting plant. The new facilities will not only provide room for these workers to expand their activities and operate more efficiently, but also make possible a considerable increase in the company's total research activities.

One of the results will be availability of space for returning veterans without displacement of any of the present research staff. The company plans to take back 179 laboratory employees still with the armed forces without dismissing any of their temporary replacements. Not all the research workers will be accommodated

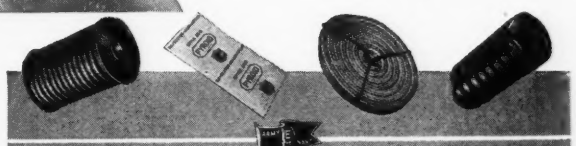
the winner that never scores



For reciprocating-rods, the winning packing is the one that never scores. That's why experienced maintenance-men for more than forty years have been picking non-scoring R/M packings for trouble-free service on pumps and stuffing-boxes.

For thousands of other kinds of industrial equipment, R/M packings are doing a winning job. Made of specially chosen materials, designed to meet the particular needs of different types of service, they are available in a complete range of sizes, and in coil, roll, spiral, bulk, and flat form. If you have special packing needs, we will make any shape you require.

Ask your distributor for the catalog on the complete R/M line.



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in the new plant, however, as the technical service group will continue in the refinery, close to the operations they serve.

Diesel Facts

GROWING DEMAND FOR Diesel engines for producing the power in municipally-owned power plants is revealed in a new booklet published by Diesel Engine Manufacturers Association, 1 N. LaSalle St., Chicago 2, Ill. Covering the use of Diesels in city power plants, the booklet is the first of a series to be issued by the association under the general title, "Diesel Facts."

Prior to 1910, comparatively few Diesels were used to generate current for municipally-owned power plants. Ten years later, 38 million kw hr were being generated by Diesel engines in such plants. By 1930 the figure was 250 million kw hr, and in 1943 it had increased to nearly two billion.

The Diesel's operating economy and reliability are cited as the chief reasons for its growing popularity in this type of service. Other advantages are the simplicity and compactness of a Diesel power plant, its cleanliness, and the minimum of attention required for its operation.

A special section of the booklet treats of the procedure to be followed by a city that wants to have its own power plant. Another section outlines the widespread use of Diesel engines in the generating projects of the Rural Electrification Administration.

A survey of potential peacetime uses of Diesel engines has been made by Diesel Engine Manufacturers Association. During the war, the government has been using practically all of the Diesel engine output for propulsion in ships and boats, and for electric generating sets to be sent overseas. The industry is now in position to turn to its pre-war markets.

Future booklets to be issued by the Diesel Engine Manufacturers Association will deal with Diesel engine applications in ships and boats, locomotives, the oil industry, and various stationary usages.

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You don't have to be a regular M.D. to doctor your sick tube cleaners. You can lengthen the life and increase efficiency of most war-weary tube cleaners—if you know how. It's simple when you have a copy of the WILSON TUBE CLEANERS CHECK-LIST.

This valuable six-page folder contains a list of hints on tube cleaner maintenance and operation that will help you get better service from your tube cleaning equipment.

In addition, the CHECK-LIST contains a two-page selection guide that will enable you to choose the exact cutter-heads to fit your particular problems — cutter-heads and other accessories to replace those that are worn by hard wartime usage.

Help yourself to reduce "downtime" by consulting the WILSON TUBE CLEANERS CHECK-LIST. Your copy will be sent on request.

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Basil Manly Becomes President of Atlanta Utility

IN ANNOUNCING his resignation as Chairman and Member of the Federal Power Commission, Basil Manly stated that he had been tendered and had accepted the office of President of the Atlanta Gas Light Co. of Atlanta, Georgia.

Mr. Manly has had an extended career in Government service, having been Director of the Commission on Industrial Relations in 1914-1915 and Joint Chairman, with former President Taft, of the National War Labor Board during the latter part of World War I.

He was appointed to the Federal Power Commission in 1933 and was elected Chairman by his associate Commissioners after having served a number of years as Vice Chairman.

Addition to Marysville Plant

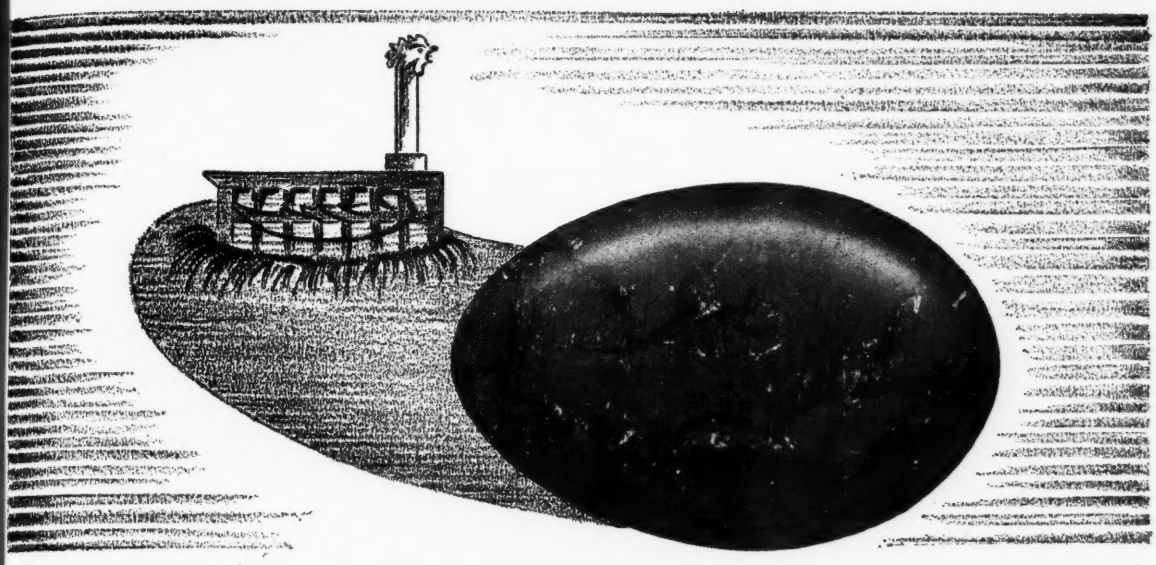
DETROIT EDISON CO. has reinstated with War Production Board approval, the order which was cancelled in 1942, for a second 75,000 kw turbine generator (No. 8) for the Marysville Power House, according to a recent announcement.

This machine was ordered originally in 1941 to provide generating capacity for anticipated additional load in the Marysville area. In December of 1942, however, changes in the planning of war production facilities which had prompted the undertaking resulted in cancellation both of this unit and of a steam-generating unit.

In addition to providing additional system capacity, two other advantages will be obtained by the Marysville addition. This unit will be one of the most efficient units on the system and will tend to lower operating costs by reducing the running hours of less efficient machines. A second benefit will be that the rather heavy cable loadings now required to feed the northeast load area of the system can be somewhat relieved.

Because of general satisfaction with the operation of Unit No. 7 during the war, the new Unit No. 8 and auxiliary equipment will be essentially identical with No. 7 Unit.

At the time the project was temporarily postponed, a considerable



This Time the "EGG" Comes FIRST

To put "first things first" with a new power plant means to make a complete fuel investigation *before* any conclusions are reached as to how the plant is to be built.

The first step involves full data on the competitive costs of the coals economically available to the plant.

Step number two is the design of the plant itself to insure flexibility and trouble-free operation on a sufficiently wide range of coal quality so that the equipment will never be restricted to any particular coal or one with limited reserves.

Equipment manufacturers and the Fairmont Coal Bureau are prepared to offer recommendations to enable you to "put first things first" in new plant construction or modernization to assure a competitive steam-generating cost far into the future on *available* coals.

Include Low Fusion Fairmont Coal in Your Fuel Investigation

- . . . **It can be burned economically in any equipment properly engineered for its use.**
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- . . . **it represents an outstanding value on a Btu basis.**
- . . . **engineering to use FAIRMONT COAL assures the lowest over-all steam cost for the life of the plant.**

Up-to-the-minute data on coal and its relation to steam plant design are available in "Reference Bulletins" which will be sent promptly on request. Ask to be placed on our mailing list. Use coupon below.

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amount of work had already been done by the turbine manufacturer. By picking up the job where it was stopped it will be possible to secure delivery of the new machine about May 1946. A construction schedule has been drawn up which provides for completing the installation of the turbine generator together with all its auxiliary equipment so that it will be ready for service the latter part of 1946.

Powel Given Foreign Assignment

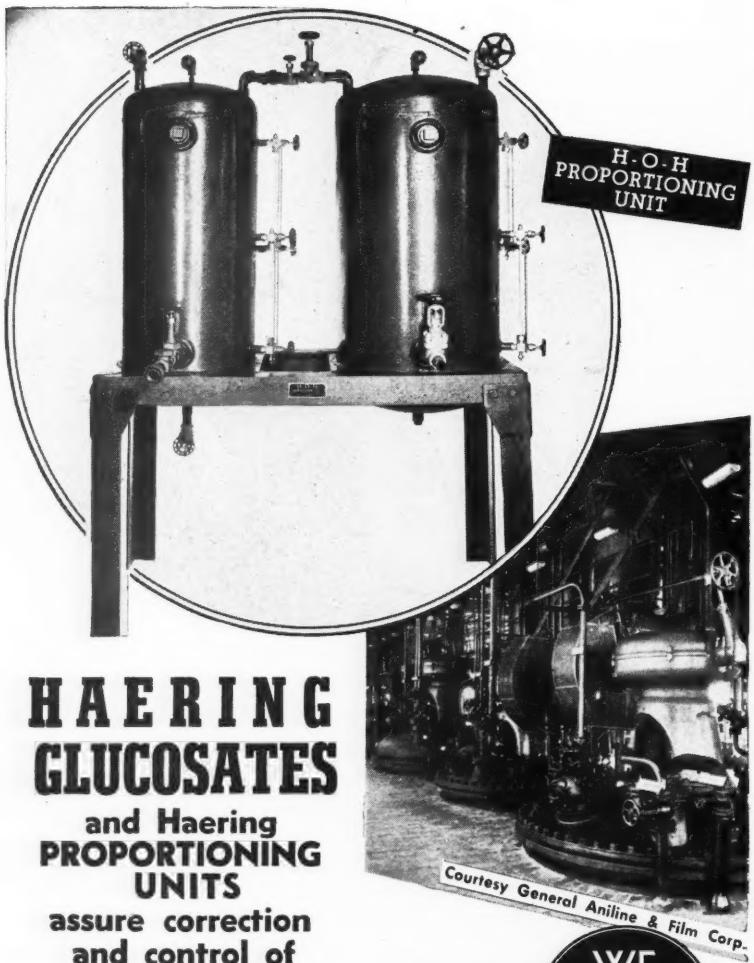
C. A. POWEL, Manager of Headquarters Engineering at Westinghouse, has been appointed by the War Department to head that branch of the Allied Control Commission in charge of Germany's electrical and radio industries.

First task will be a complete survey of all the electrical- and radio-manufacturing facilities still existing in Germany. Following this a rigid system of control is to be set up under which these industries will be permitted to resume, or convert to, the manufacture of essential civilian goods only.

Mr. Powel knows European industry, having spent the 10 years from 1905 to 1915 with the internationally-known Swiss electrical firm of Brown, Boveri & Co. Next he served with the civil branch of the British Ordnance Department during World War I and came to the United States in 1916 as an inspector with the British War Mission.

He remained here following his honorable discharge from the British service in 1919 and joined the general engineering staff of Westinghouse at East Pittsburgh, Pennsylvania, in the same year. Shortly thereafter he became an American citizen.

At Westinghouse he has supervised or been associated with many of the nation's major power projects in the fields of transportation, central station, marine, mining, and numerous others. He has also served as president (1944-45), vice president, and a director of the American Institute of Electrical Engineers.



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Research Center for Johns-Manville

PLANS FOR A NEW research center in which greatly expanded and accelerated development work will be carried on in the fields of building materials, insulations and other products urgently needed to help house the nation and increase efficiency of industrial operations in the postwar period, have been announced by Lewis H. Brown, president of Johns-Manville Corp.

The Research Center, the first unit of which is already under construction, is planned ultimately to be a group of six buildings located on a 93-acre plot of land near Bound Brook, N. J., and across the Raritan River from the Johns-Manville plant at Manville, N. J.

Dr. C. F. Rassweiler, Vice President and Director of Research, in describing the new Research Center, said that the first unit, in addition to research laboratory facilities, will also "provide 10 experimental factories under one roof. Projects initiated in the research laboratory may thus be carried clear through their development and pilot-plant production stages. This is expected to speed up the development of new and improved materials for building and for industrial uses, since new products will be more nearly ready for commercial manufacture when they emerge from the Research Center."

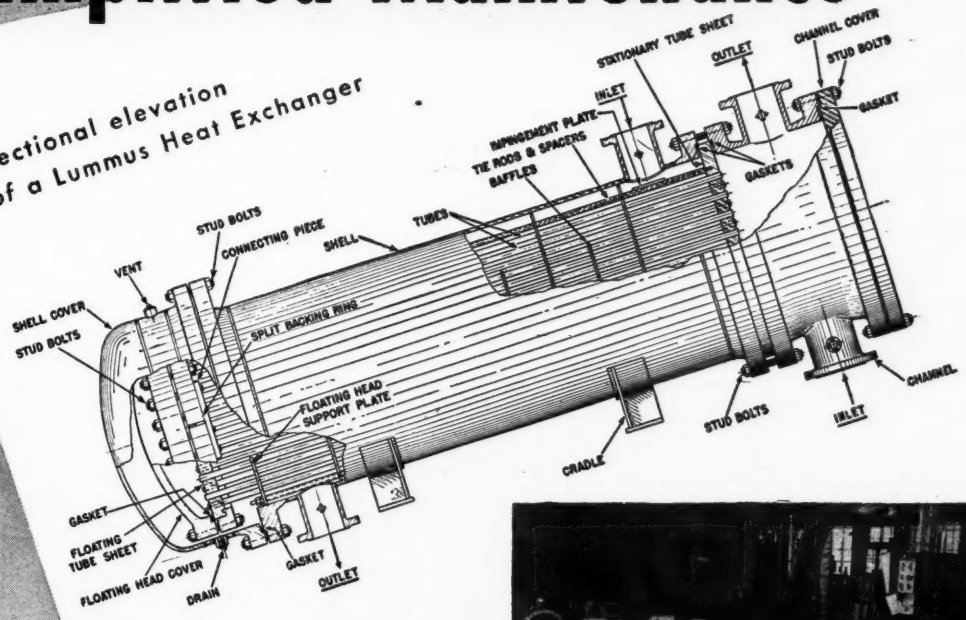
Buildings projected for the completed Center, plans for which are being drawn by the architectural firm of Shreve, Lamb and Harmon, consist of a Research Laboratory and Administration Building, two combination Laboratory-Factory Buildings, a Research Engineering and Machine Shop Building, a Water Filtration and Waste Processing Building, and a Garage and Stores Building.

Gas Turbine Laboratory for MIT

GIFTS TOTALLING half a million dollars for establishing a gas turbine laboratory at the Massachusetts Institute of Technology for graduate instruction and fundamental research in this new and promising field of engineering, have been announced by Dr. Jerome C. Hunsaker, head of the departments of aeronautical and mechanical engineering.

Simplified Maintenance

Sectional elevation of a Lummus Heat Exchanger



1 BASIC DESIGN
6 STANDARDIZED SIZES
for 102 OPERATING UNITS

Simplified maintenance is of major importance in isolated overseas oil refinery operation. Here again, Lummus experience — in designing and fabricating heat exchangers — solves a war-time emergency with soundly based, simplified design. Tube bundles, gaskets, etc., are held to one basic design in six standardized sizes. A maximum degree of interchangeability is permitted with an absolute minimum number of spare parts.

In all, a carefully calculated engineering feat in simplification — for a complete oil refinery installation requiring one hundred and two heat exchanger operating units.

Lummus engineering service is always available for the study of specific heat exchanger problems. For further information write to: The Lummus Company, 420 Lexington Avenue, New York 17, N. Y.

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LUMMUS EQUIPMENT

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LUBRICATING OIL COOLERS
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PIPE LINE COOLERS
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FEED WATER HEATERS
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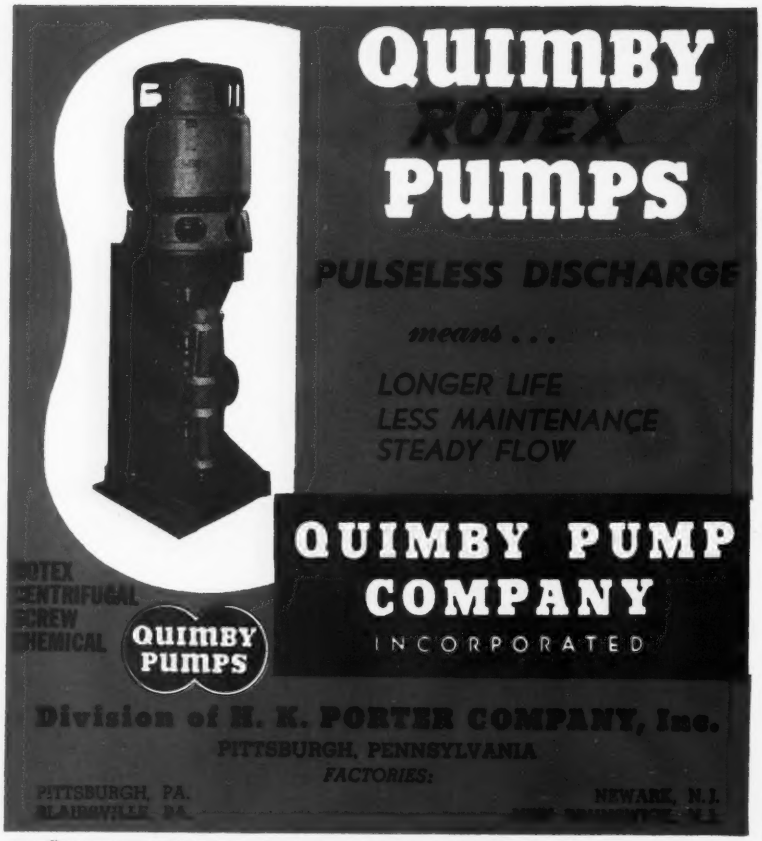
JACKET WATER COOLERS



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meet all tests . . . assure you lifetime trouble-free service
● Swartwout Heaters guarantee the preheating capacity and oxygen removal needed for your boilers—faithfully and economically. They help your plant to deliver full capacity . . . keep maintenance low . . . help save fuel.
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POWER PLANT EQUIPMENT

Recent advances in gas turbine design indicate significant possibilities for the future and emphasize the need for specialized technical studies and the discovery of new techniques required in the construction of machines operating at extremely high speed, high temperature, and high compression. The Institute's new laboratory, which is to be completed as soon as possible, will undertake such a program. Its equipment will include a supersonic wind tunnel and unique facilities for research on the elements of compressors, combustion devices, jets, and gas turbines. Test facilities will also be provided for the operation under controlled conditions of such devices.

The Institute is fortunate in having on its staff a number of men who are recognized leaders in their respective professions and who have had considerable experience with gas turbines or their component parts, or in closely related fields.

The Institute's visiting committee on aeronautical engineering under the leadership of Gordon S. Rentschler made arrangements for financing the project, the early realization of which is made possible by substantial grants from a group of leading industries, all of which will benefit from fundamental research on gas turbines. Those contributing to the program include, Alfred P. Sloan, Jr., chairman of the board of General Motors Corp. and a life member of the Institute's corporation; the General Electric Co.; the Westinghouse Electric Corp.; the United Aircraft Co.; the Hooven, Owens, Rentschler Co.; and the Curtiss-Wright Corp. Professor Edward S. Taylor is project engineer for the laboratory, and the firm of Jackson and Moreland are consultants.

Municipal Power Plant for Detroit

DETROIT PLANS TO BUILD A $5,421,300 power plant to supplement the Public Lighting Commission's plant and thus provide the commission with generating capacity ample to meet its anticipated peak demands until 1954, Major General Philip B. Fleming, Federal Works Administrator, disclosed recently. He allotted the city a Federal advance of $150,000 to supplement $200,000 of city funds for preparation of plans.

The Federal funds will be made available through the Bureau of Community Facilities, Federal Works Agency, and are to be repaid without interest, when construction is begun.

The new plant will be built on city-owned property along the Detroit River at a point yet to be selected. As its first unit, it will contain a 35,000 kw hydrogen-cooled straight condensing turbo-generator, designed to operate on 1650 psi steam at the intake and at a temperature of 1000 F.

Included in the project will be the docks and coal-handling equipment required for the plant. Ample space will be provided for storing coal, as the year's supply is brought in by water during the season of navigation.

The first unit of the new plant, combined with the 80,000 kw capacity of the present plant, will give the Public Lighting Commission a generating

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vertical flow
Bent Tube Boiler . . .

. . . one of **many** Edge Moor Types

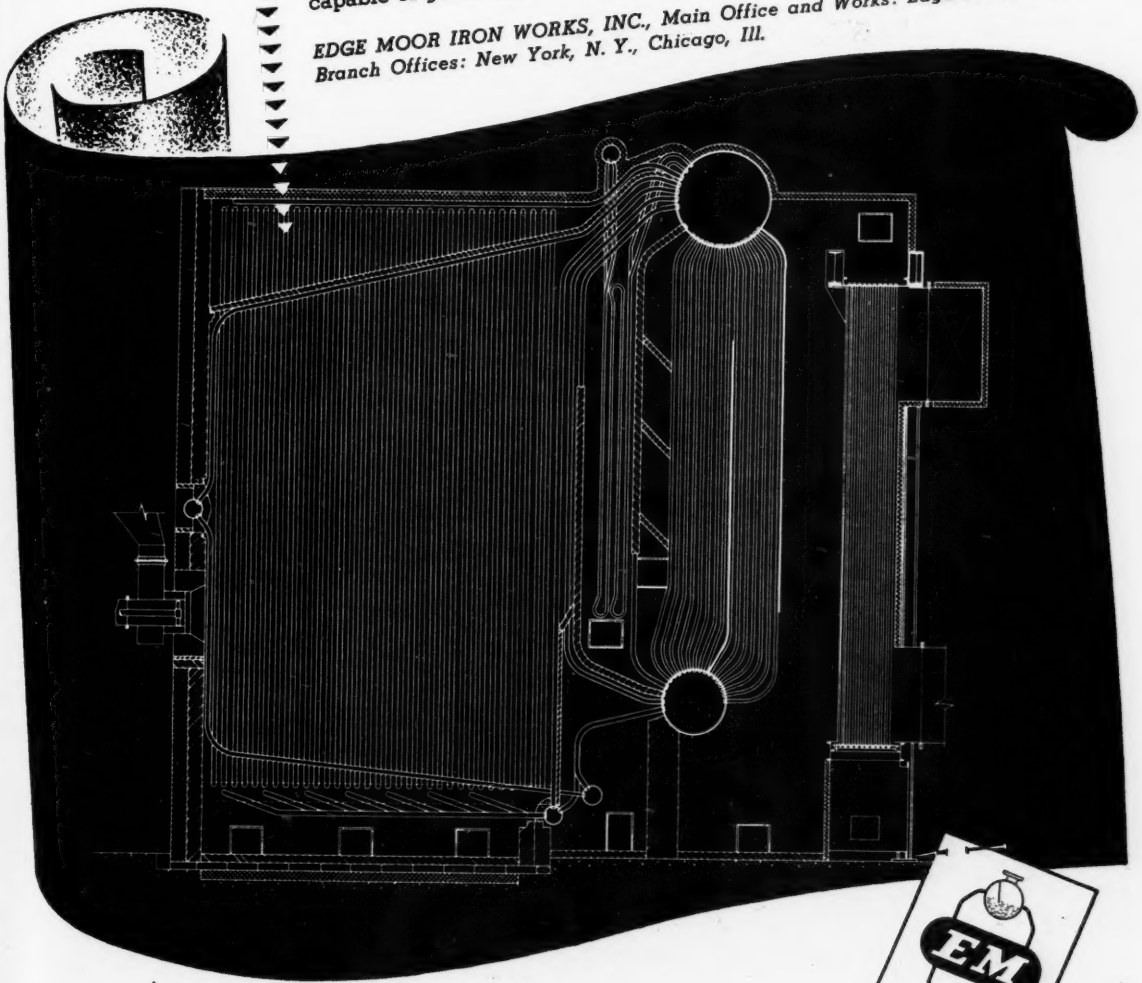
• Edge Moor boiler design is and always has been flexible. No single type will furnish steam under all circumstances and requirements as satisfactorily and economically as a boiler adapted to those requirements and conditions.

• The Edge Moor Vertical Flow Boiler is designed for maximum output in a limited space. It is a combination of a simple two-drum boiler bank, having perfect U-tube circulation, and a water cooled furnace, integral with the boiler. The large amount of surface exposed to radiant heat results in a quick steaming unit that will give rapid response to load changes.

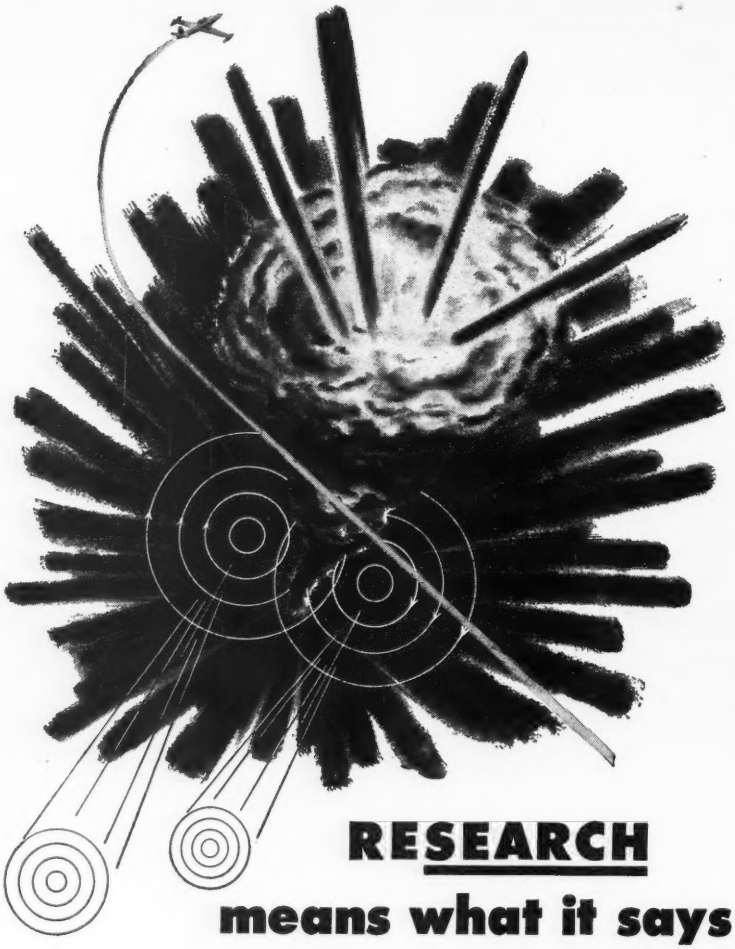
• The Edge Moor Vertical Flow Boiler is adaptable to all methods of firing both solid and liquid fuels. It is available in sizes from the smallest to units capable of generating 200,000 lbs of steam per hour.

Edge Moor Vertical Flow Unit with Edge Moor Superheater and tubular Air Preheater; arranged for pulverized coal firing.

EDGE MOOR IRON WORKS, INC., Main Office and Works: Edge Moor, Del. Branch Offices: New York, N. Y., Chicago, Ill.



EDGE MOOR Steam Generating Equipment



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Chicago Metal Hose Corporation's 43 years of experience went into manufacturing its part of *Jet Propulsion, Pressurized Cabins* and kindred marvels of a modern day.

For each of these scientific achievements began with research. A *search* by trained men months and years ago for better tools, better metals, better ways of doing things.

This pioneering has made for scientific advancement in the manufacture of flexible metal hose. Today, for example, Chicago Metal Hose Corporation can offer *you* outstanding advantages. Our engineers are specialists in the science of fabricating and corrugating Stainless Steel and other metals. Out of our long experience have come new techniques in *metal strip forming* and *welding* that are increasing efficiency on hundreds of industrial applications. If your problem involves flexible metal tubing, bellows or allied products. . . find out now how we can help you! Write today.

Flexible Metal Hose for Every Industrial Use

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CHICAGO METAL HOSE CORPORATION

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capacity of 115,000 kw. Current estimates forecast a peak demand on the commission's system of 100,000 kw by 1954. Good operating practice requires a minimum reserve of 15 per cent above peak demand, electrical engineers estimate.

F. L. Hovde to Head Purdue

FREDERICK LAWSON HOVDE, 37, assistant to the president of the University of Rochester and now on leave as head of the rocket development program for the government, has been chosen president of Purdue University, succeeding Edward C. Elliott, president emeritus who retired June 30.

Dr. A. A. Potter will continue to serve as acting president temporarily.

Hovde, born in Erie, Pa., in 1908 spent his boyhood in the North Dakota farming community of Devils Lake. Later he attended the University of Minnesota, receiving his bachelor's degree in chemical engineering in 1929.

Selected for a Rhodes scholarship from North Dakota, he did research work in physics and chemistry at Oxford, England, from 1929 to 1932, receiving both bachelor's and master's degrees there.

Safety Program Announced

A SPECIFIC PROGRAM designed to help industry meet the threat of an increased accident toll under the changed conditions of the postwar period has just been offered by 38 national organizations interested in industrial safety.

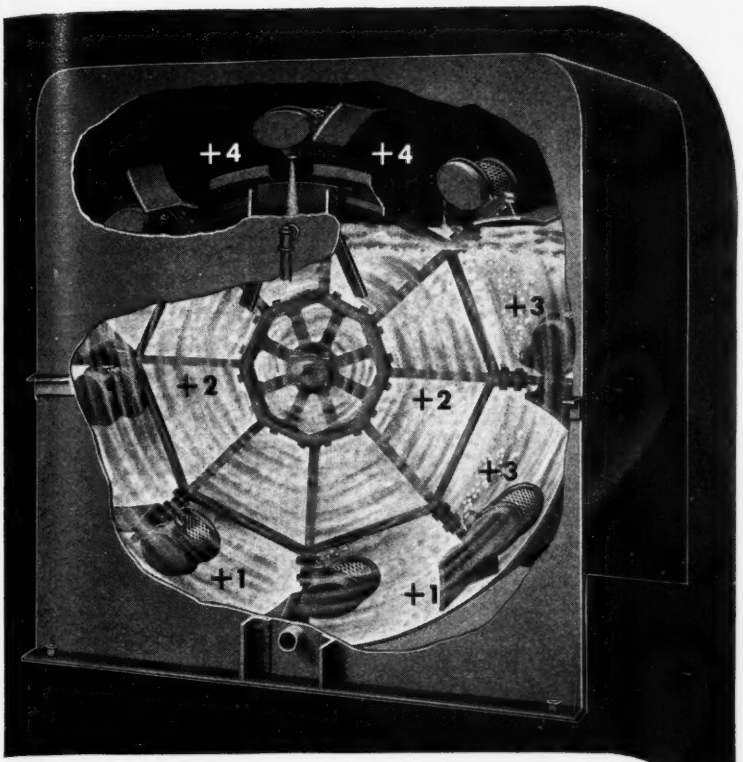
The program is contained in a 16-page pamphlet, "Industrial Safety Tomorrow," produced by the National Safety Council for the co-operating organizations. The sponsoring organizations include industrial management associations, labor unions, civic organizations, educational institutions and insurance associations.

Preparation of the pamphlet was handled by a special Committee on Post-War Industrial Safety, headed by C. R. Cox, president of the National Tube Company of Pittsburgh, Pa., a subsidiary of the U. S. Steel Corp.

Incentive Wage Plans

THE DOUGLAS T. STERLING CO., management consultants, have recently completed a survey of incentive wage plans now in use to determine from users their opinion of incentives as an aid in meeting potential demands of labor in the post-war period.

Questionnaires mailed to a nationwide sampling list of 2400 industrial organizations were answered by 306 users of incentive wage plans. From their answers a 24-page booklet has been prepared which commences with a three-page introductory summary of the survey, follows with 11 pages of direct quotations, lists the 61 industries that participated and concludes with the principles of wage incentives as set forth by the N. A. M. Copies of the booklets are available without charge upon request from The Douglas T. Sterling Co., Research Division, Stamford, Conn.



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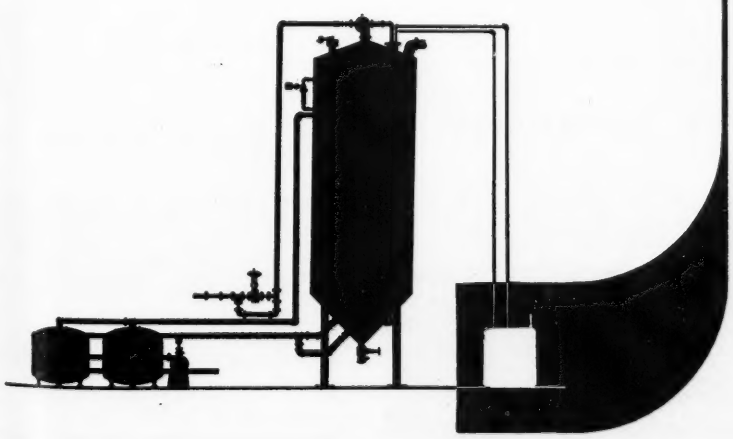
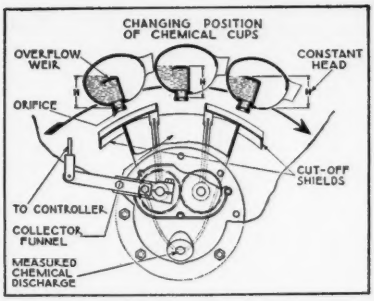




A constant head over a constant orifice in any discharge position.

INFILCO Chemical Mixers and Feeders contribute greatly to the enviably successful operation of Hot-Flow Softeners.

Their function is to hold a chemical solution, or mixture, at a uniform strength—and, to feed it accurately.

They are doing just that—year after year—because of the cumulative effects of these plus value design features—

+1 The half-rounded bottom—with plow-shaped agitators sweeping close—eliminates dead spaces where any solids can deposit.

+2 Agitators—revolving vertically—circulate the mixture in a positive up and down motion. Stratification is impossible.

+3 As the cup moves down, trapped air escaping from its discharge orifice, blows out obstructions—keeping the orifice clean.

+4 Every chemical cup is designed to maintain a constant head over the orifice during the entire period of discharge.

And the cumulative results are—

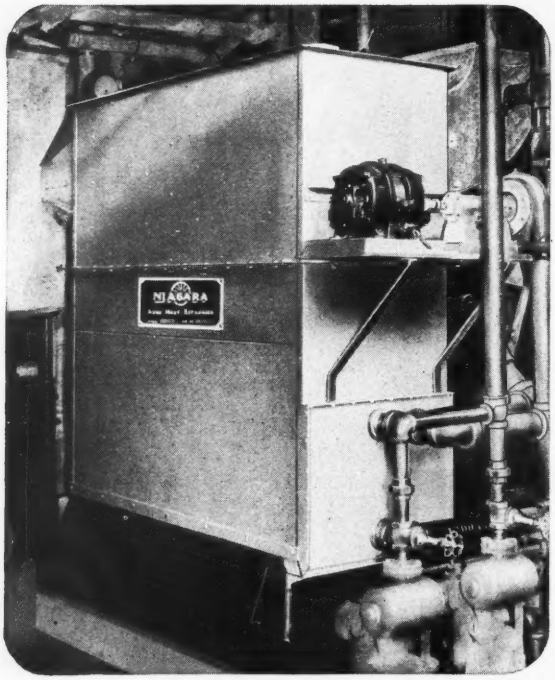
+1 + +2 = ***Uniform Solution or Mixture.*** Samples, taken at random from the Mixer and Feeder, will never vary in chemical content more than 1½%.

+3 + +4 = ***Accurate Feeding.*** A constant head over a constant sized orifice is a precise means for feeding an unvarying volume of solution.

Not only the Infilco Mixer and Feeder, but also every other component part of the Hot-Flow Softener, has plus value features—every one of which contributes to smoother and more efficient operation. That's why Hot-Flow softening for boiler feed is hot process softening plus.

INFILCO

INFILCO
INCORPORATED
325 WEST 25TH PLACE, CHICAGO 16, ILL.



Trustworthy Water Jacket Cooling for Industrial Power Equipment

Ample cooling capacity, with freedom from the maintenance troubles of open-system water cooling, supports higher production.

The NIAGARA AERO HEAT EXCHANGER provides a closed system of re-circulated, clean jacket water at a controlled temperature. Operating your diesel or gas engines or other machinery at the correct temperature assures you of full-rated power, and freedom from frequent shut-down and mechanical trouble.

Using the NIAGARA AERO HEAT EXCHANGER also provides operating economies that quickly pay for the equipment. The heat is removed by air and the high cost of cooling water is eliminated.

Write for Bulletin 96 for complete information.

NIAGARA BLOWER COMPANY

Over 30 Years of Service in Industrial Air Engineering

DEPT. PP-105 6 E. 45th St. NEW YORK 17, N.Y.

Field Engineering Offices in Principal Cities

INDUSTRIAL COOLING HEATING • DRYING

NIAGARA

HUMIDIFYING • AIR ENGINEERING EQUIPMENT

CLASSIFIED ADVERTISING

HELP WANTED

POWER ENGINEERS

ENGINEERS for field service starting up new boilers and auxiliary equipment for large manufacturer. Must be technical graduate or have good background of operating experience with pulverized fuel. Salary to start $200 to $400 per month depending upon qualifications. Address Box 1491, Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Ill.

DESIGNERS, draftsmen, piping and equipment post-war steam-electric plants. Chicago location. Laramore and Douglass, Inc., 327 S. LaSalle St., Chicago 4, Ill.

WANTED: Electrical Engineering graduate for permanent position as Chief Electrician's assistant in large public utility generating station located in the East. Address Box 1489, Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Ill.

POSITION WANTED

CHIEF ENGINEER available for Industrial or Utility Diesel Electric power plant. Will locate anywhere. Address Box 1490, Power Plant Engineering 53 W. Jackson Blvd., Chicago 4, Ill.

SALESMEN AND AGENCIES

WANTED: RELIABLE SALES ENGINEERS to represent established manufacturer of Fuel Burning Equipment, Industrial Oil, Gas, Pulverized Coal Burners and Refinery Equipment. Faber Engineering Company, Amber & Westmoreland Sts., Philadelphia 34, Pa.

•

BUY VICTORY BONDS

AND KEEP THE BONDS YOU HAVE

•

It's Nugent! ... for

Fuel and Lubricating Oil Filters

THE widespread use of NUGENT Absorbent Type Fuel and Lubricating Oil Filters is indicative of how industry is helping to conserve lubricating oils and fuel oils. During NUGENT'S 48 years' experience in the manufacturing of filters, many thousand NUGENT filters of all types have been installed on commercial and naval vessels, in stationary engine plants, Diesel locomotives, cement mills, rubber mills, steel mills, etc.

THE IMPROVED NUGENT DEPTH TYPE PRESSURE FILTER

Figs. 1280A 4L, 1280AU 4L4, and 1280A 4L3 show several NUGENT Oil Filters. This type of filter is equipped with one or more standard filter cartridges in a single container or shell of various sizes depending upon the filtering capacity required. All cartridges are alike and interchangeable regardless of whether they are the Repackable type or the Replaceable ("throw away") type. Both types are made for capacities from 1 up to 2248 H.P. in single containers or shells. (Navy specifications.)

NUGENT Fuel Oil Filters are made for Diesel engines from 1 to 384,000 H.P. in single containers.

NOTE THESE SUPERIOR NUGENT FEATURES:

- Easy and neat piping installation because inlet and outlet openings are on opposite sides of the filter, close to the bottom.
- Filters have built-in by-passes—will take full flow or by-pass filtering.
- Drain plugs.
- Air vented.
- Reduces the neutralization number of lubricating oil from 0.40 to 0.04.
- Very inexpensive "Throw Away" Replaceable cartridges.

NUGENT FILTERS ARE EFFICIENT FOR KEEPING ALL TYPES OF LUBE OIL CLEAN

Fig. 1317B graphically shows how NUGENT Filters remove harmful grit, dust, sand, carbon, abrasives, etc., from lubricating oils. Picture shows a lube oil sample of *before* and *after* installing a NUGENT ABSORBENT (waste) Type Oil Filter on a 600 H.P. Diesel. The *"after"* sample was taken at 1800 hours' operation. Waste is renewed every 700 hours. The line through the *"after"* picture is human hair. The large dirt particles in the *"before"* sample are about .0017.

NUGENT filters enable manufacturers and power plant operators to conserve fuel and lubricating oil.

Fig. 1280A 4L illustrates a shell containing one cartridge.

Illustration of the Replaceable ("throw away") type recharge.

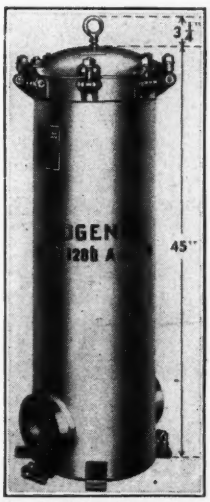


Fig. 1280A 4L3 illustrates a shell containing three cartridges.

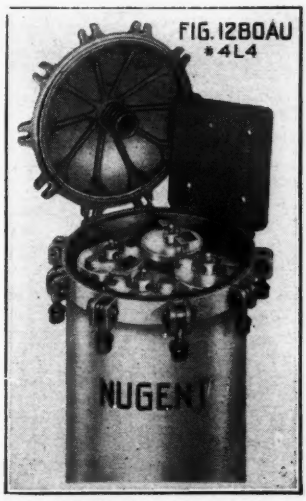
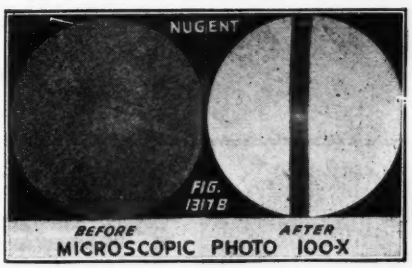


Fig. 1280AU 4L4 shows arrangement of four cartridges in one shell. Other size shells are made to contain one to twelve cartridges.



Nugent Filters

ESTABLISHED 1897

WM. W. NUGENT & CO., INC.

423 N. HERMITAGE AVE. CHICAGO 22, ILLINOIS

Fuel Oil Filters • Lube Oil Filters • Lubricating Systems • Sight Flow Indicators • Filter Bags

When speed counts, you can count on

ROTO

TUBE CLEANERS

to finish the job faster. One-man operation saves labor, too

ROTO Division of Elliott Company
145 Sussex Ave., Newark 1, N. J.

ALLPAX

THE PACKING THAT "PACKS ALL"

. . . use it once and
. . . you'll use it always

Here's the universal packing that can be used for any fluid or on any apparatus—economically, efficiently—tightly—simply.

Try ALLPAX and you, too, will be enthusiastic over its easy application and long wear. You don't have to remove old packing to repack with ALLPAX. Square cross section makes ALLPAX easy-filling in any stuffing box.

Try it and you'll always use it. Full details on request.

THE ALLPAX CO., INC.
Mamaroneck, N. Y.

●

Distributors Everywhere

REMOVES SOOT & FIRE-SCALE WHILE BOILERS OPERATE

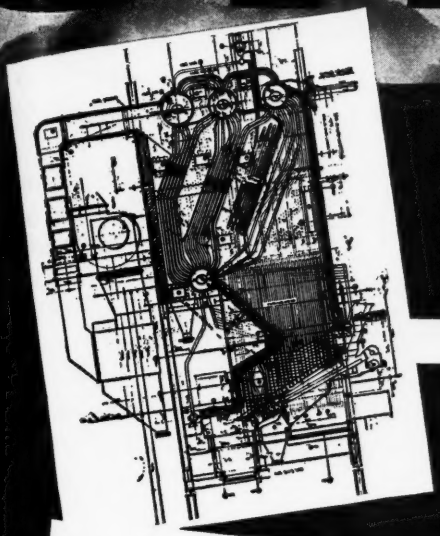
CHIPPING AND SCRAPING IS UNNECESSARY when you use XZIT. Simply feed XZIT into the firebox while the boilers operate. When thrown on the fire in a furnace it forms a gas which permeates all parts of the boiler, the uptakes, and the stack and has a chemical reaction on the soot and fire scale.

XZIT can be used to extinguish stack fires and to stop sparking. Regular use keeps boilers and stacks clean and free of soot and fire-scale.

Used by all types of merchant and naval ships, XZIT is a proved product. Write for demonstration or order a trial supply. There is an XZIT representative near you.

XZIT FIRE SCALE & SOOT ERADICATOR
1031 CLINTON STREET, HOBOKEN, N. J.
5800 S. HOOVER, LOS ANGELES, CALIF.

STEAM *for*

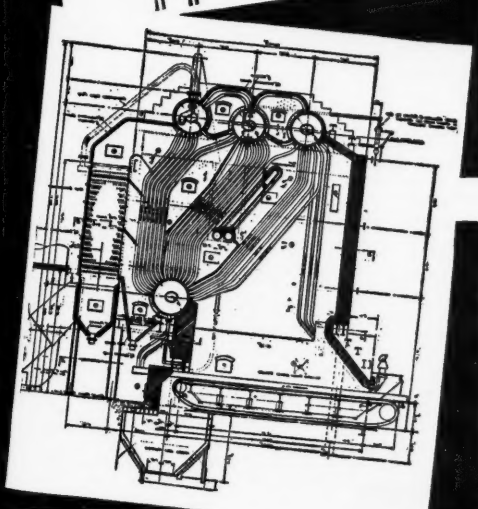


POWER

SOUTHERN COLORADO POWER COMPANY
Pueblo, Colo.

90,000 lbs. steam per hour Vogt LE type bent tube boiler with underfeed stoker. Water walls and economizer. Design pressure 525 lbs. Total steam temperature 750 degrees F.

•

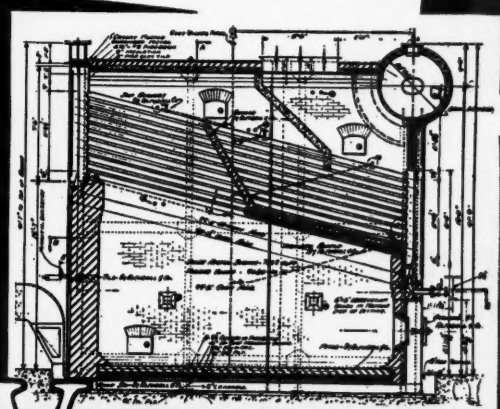


PROCESS

IN A LARGE MID-WESTERN STEEL MILL

Two 105,000 lbs. steam per hour Vogt LE type bent tube boilers with chain grate stokers and economizers. Design pressure 225 lbs. Total steam temperature 550 degrees F.

•



HEATING

CRIMINAL COURTS BUILDING AND JAIL
New York City

Four Vogt sectional header type boilers of 47,000 lbs. steam per hour capacity, oil fired. Design pressure 200 lbs.

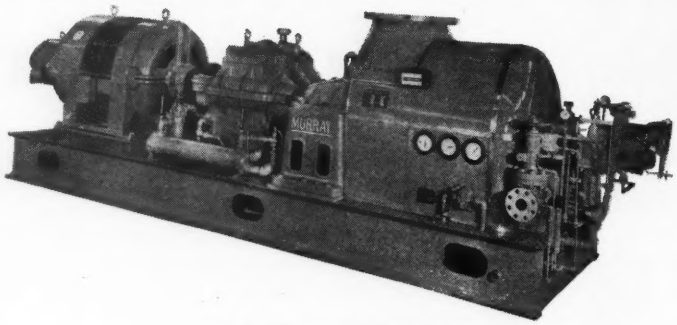
HENRY VOGT MACHINE CO.
LOUISVILLE, KENTUCKY
Branch Offices: NEW YORK CLEVELAND CHICAGO PHILADELPHIA DALLAS

Vogt FOR BETTER BOILERS

Vogt *Water Tube* BOILERS

BENT TUBE AND SECTIONAL HEADER TYPES

MURRAY
TURBINE-GENERATORS



500 KW — PACKAGE TYPE

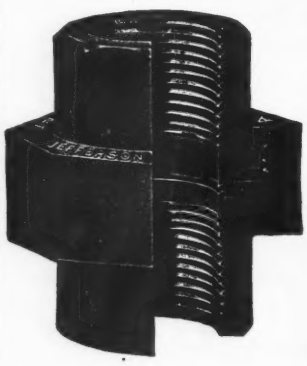
The unit shown was designed to deliver 500 KW alternating current on steam at 285 lb Gauge initial pressure, 700 degrees F. total temperature and 27 inches vacuum. Provided with a rigid structural steel baseplate, and with all service connections except generator leads above the floor line, the machine can be handled as a unit and installed with a minimum of preparation.

While "Package Type" units were furnished for export for installation in remote areas not previously supplied with power, the design can be utilized for small industrial plants for main or standby power supply.

MURRAY also produces

Mechanical Drive Turbines—Horizontal and Vertical
Reduction Gears
Steam Boilers

MURRAY IRON WORKS COMPANY
BURLINGTON, IOWA
BUILDERS OF STEAM POWER EQUIPMENT FOR THREE QUARTERS OF A CENTURY



The Feature of the RECESSED BRASS SEAT in the

JEFFERSON UNION
makes it unique

It is cut from seamless drawn tubing—free from all casting defects—sound and uniform always! It cannot be dislodged by a pipe end screwed in too far.

JEFFERSON UNION CO.
601 West 26th St., New York 1, N. Y.
Factories at Lexington 73, Mass., and Lockport, N. Y.

60 Seconds DOES IT!

Taylor LIQUITROL

THE MODERN METHOD TO CONTROL pH, CHLORINE AND PHOSPHATES

For right-on-the-spot control and prevention of corrosion in boilers . . . engineers and chemists in leading plants rely on Taylor Liquitrol Method.

This method enables them to make accurate determinations of pH and Chlorine in 60 seconds . . . phosphates in 2 minutes . . . in any part of their plants.

Accuracy of their determinations with Taylor Liquitrol Method is assured for all Taylor Liquid Color Standards are unconditionally guaranteed against fading.

***JUST OFF THE PRESS . . . NEW 88 PAGE BOOK** . . . gives solutions of problems in 34 industries including yours. Also details of Taylor Liquitrol Methods, procedures and portable outfits, etc. See your dealer or write direct for your free copy.*

W. A. TAYLOR AND CO.
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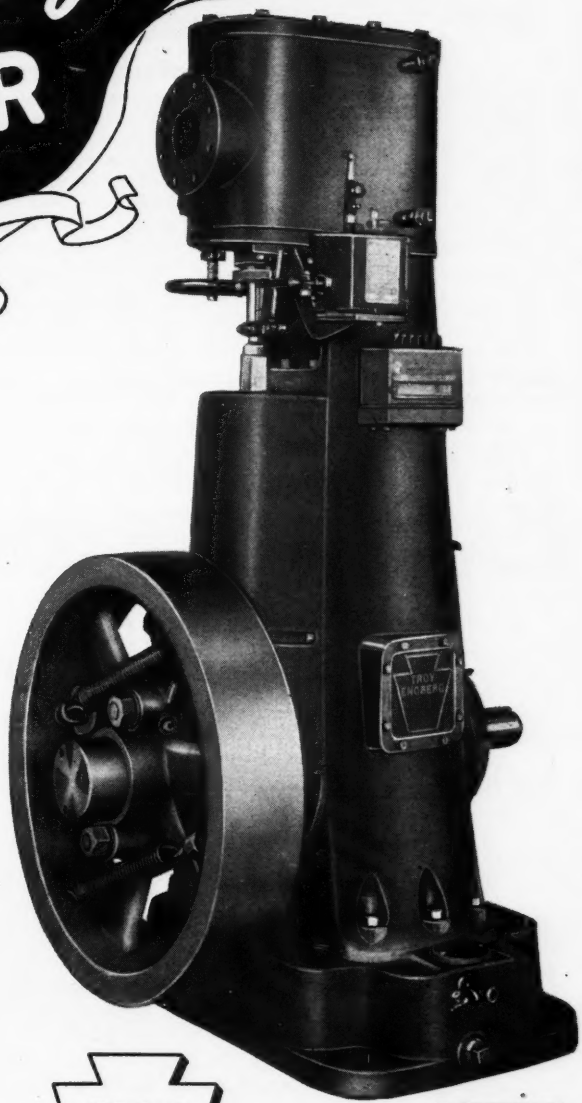
USE Steam Engine POWER



★ **FOR ECONOMY**

★ **FOR FLEXIBILITY**

★ **FOR DEPENDABILITY**

Troy-Engberg Steam Engines are the most economical drive obtainable when plant heat balances are right, as they are in many plants. In these cases, generally power costs are so low as to completely pay off all investment and installation costs in a few months or a year or two.

That Troy-Engberg Engines are flexible is evidenced by the fact that many companies, including utilities, have installed them for driving stokers on boilers operating under widely fluctuating loads.

As for dependability, we refer you to oil refineries where many Troy-Engberg Steam Engines are driving those important charging and transfer pumps. Dependability is the first requirement.

The modern reciprocating Troy-Engberg Steam Engine has so much to offer that its use should be considered for every drive in your plant. Single engines range up to 225 hp, vertical or horizontal; duplex, up to 450 hp.

TROY ENGBERG

FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS

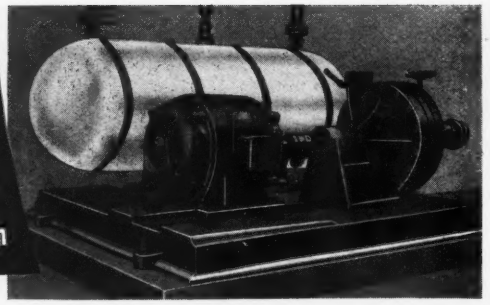
TROY ENGINE & MACHINE CO.

Established 1870

880 RAILROAD AVENUE **TROY, PENNSYLVANIA**

10-TEM-4

Increase YOUR PRODUCTION with the STOUT NO-VENT Boiler Return System



—for Cookers, Heaters, Driers, etc.

It operates continuously returning condensate, ALL OF IT, fast as formed and at the same pressure and temperature at which it leaves the steam heated units. Air and non-condensibles are then automatically removed and the condensate, in the form of distilled water, returned direct to boiler. There are no traps or orifices in the system.

High temperature direct return saves fuel. Often 25% or more. (This would offset the 20% cut expected in soft coal deliveries to industry as announced July 14th by Secretary Ickes.)

Improved circulation the Stout NO-VENT way uniformly increases the temperature in steam heated units and increases production. Reducing boiler load and returning distilled water prolongs boiler life.

If you operate steam heated cookers, heaters, driers, ironers, clothing presses, drying ovens, oil tanks, water tanks, pickling tanks or have other uses for so-called "process steam" investigate the Stout NO-VENT Boiler Return System. It can boost your production.

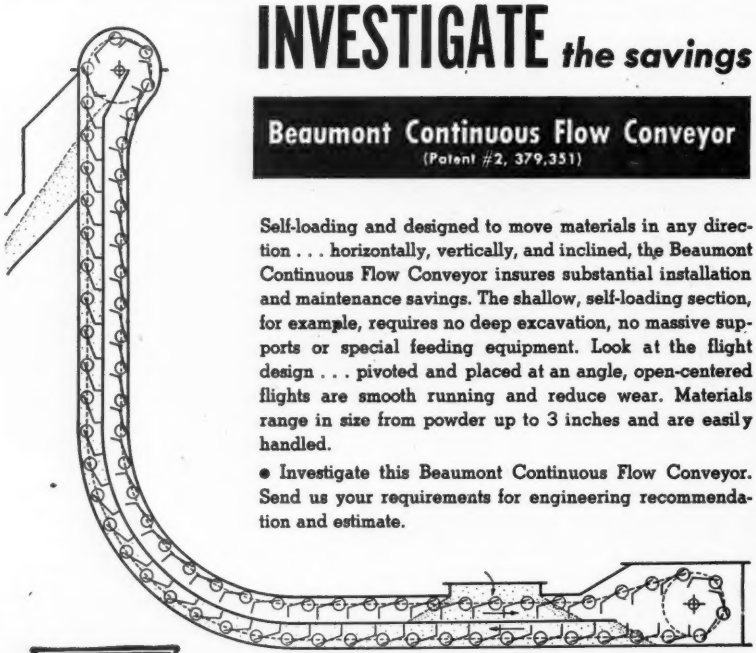
DAVID STOUT & SONS • 6 N. Michigan Ave. • CHICAGO 2, ILL.

Heat Reclaimers • Steam Condensers • Spiro Water Heaters • Gas Fired Boilers

Write for bulletin showing hookup of Stout NO-VENT System and giving operating details. Made in capacities 100 to 800 bhp, pressures to 200 lb. Distributors will be interested in selling franchise.

Stout NO-VENT BOILER RETURN SYSTEM

INVESTIGATE *the savings*



Beaumont Continuous Flow Conveyor
(Patent #2, 379,351)

Self-loading and designed to move materials in any direction . . . horizontally, vertically, and inclined, the Beaumont Continuous Flow Conveyor insures substantial installation and maintenance savings. The shallow, self-loading section, for example, requires no deep excavation, no massive supports or special feeding equipment. Look at the flight design . . . pivoted and placed at an angle, open-centered flights are smooth running and reduce wear. Materials range in size from powder up to 3 inches and are easily handled.

• Investigate this Beaumont Continuous Flow Conveyor. Send us your requirements for engineering recommendation and estimate.

BEAUMONT BIRCH COMPANY

1503 RACE STREET PHILADELPHIA 2, PA.

DESIGNERS • MANUFACTURERS • ERECTORS OF COAL AND ASH HANDLING SYSTEMS

UNIFORM ACCURACY TO 1250°F

PRINCO

HIGH TEMPERATURE MERCURIAL THEMOMETERS

Here is the line of mercurial thermometers that maintain constant, uniform accuracy over the broad range from 30° to 1250°.

The Princo High Temperature Thermometer combines four outstanding developments in design and construction for accurate high temperature measurement:

1. Princo research has produced a unique, pressure-filling process that insures the stability of the mercury column at extreme temperatures.
2. The special glass tubing used by Precision has heat resistance 300° above that of ordinary high temperature tubing, and provides the tensile strength necessary to withstand the required internal gas pressures.
3. Princo's triple distillation process assures the absolute purity, with resulting accuracy, of the mercury in the column.
4. Princo designers have eliminated excessive build-up of internal pressure by means of an expansion chamber above the mercury column.

IN USE TODAY

on Diesel Engine Exhausts . . . for Stack Temperatures . . . on Molten Metal Baths. . . . In power plants on superheated steam lines and similar applications. . . . In the Chemical and Process Industries in place of low temperature electrical pyrometers . . . on Industrial Furnaces for salt bath heat treating.

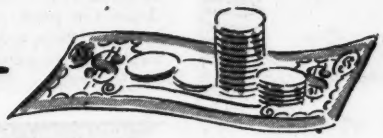
Princo High Temperature Thermometers offer accurate measurement at low cost, elimination of electrical connections, and simple, maintenance-free operation. Write today for complete data and prices.

PRECISION THERMOMETER & INSTRUMENT COMPANY

PRINCO

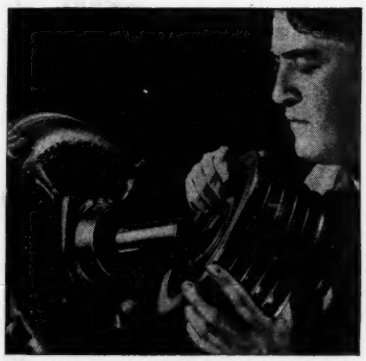
PRECISION INSTRUMENTS FOR INDUSTRY

1421 Brandywine Street, Philadelphia 30, Pa.

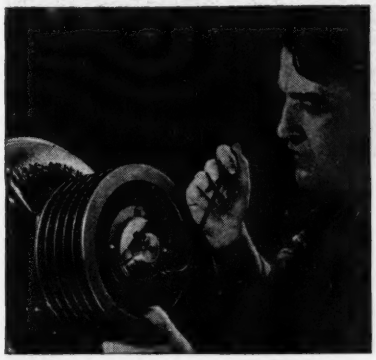
Trade this for this ; save and 

No more *forcing* of sheaves. Simple wrench operates Allis-Chalmers' "Magic-Grip" — *fastest mounting and demounting sheave on the market.* Saves time, money.

SEE HOW QUICKLY, EASILY THIS NEW SHEAVE MOUNTS AND DEMOUNTS



1 Place sheave on shaft. Slides on smoothly because clearance is provided by expanded bushing. There's *no* hammering — *no* forcing! Complete sheave and bushing unit comes intact—ready for quick, easy mounting.



2 Align exactly, using straightedge, (It's easy with this free-sliding sheave.) Then tighten three cap-screws; sheave is locked to shaft, *grips like-magic!* No set screws to damage the shaft. Write A-C for Bulletin B6310.

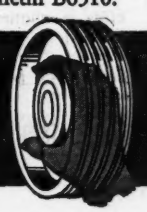
RECONVERTING?

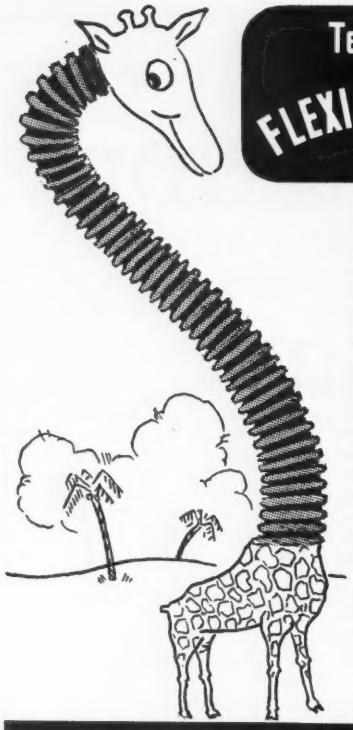
GET THIS NEW FREE KIT!

To help you find out how your present equipment will fit into future production, A-C offers a new free "Reconversion Inventory Kit" — Fact Sheets and Check Lists to speed your appraisal of V-belt drives, electric motors, and centrifugal pumps. Applies to all makes. Call your A-C distributor or district office, or write Dept. 00, ALLIS-CHALMERS MFG., Milwaukee 1, Wisconsin.

A 1855

Allis-Chalmers Texrope

"MAGIC-GRIP"  SHEAVES



Tell us about your
FLEXIBLE PIPING PROBLEMS

Our engineers will be glad to put at your disposal their experience in helping answer hundreds of tough problems on handling of oils, chemicals, refrigerants, gases, air, steam, and other fluids where expansion and vibration are present.

The marked ability of ECLIPSE Seamless Metal Hose to withstand punishing heat and jarring comes from its deep parallel sidewall corrugations which combine *maximum flexibility* with *long working life.* Steel Hose can be produced up to 40 in. I. D. Metal Hose is made in two degrees of pitch, normal and close.

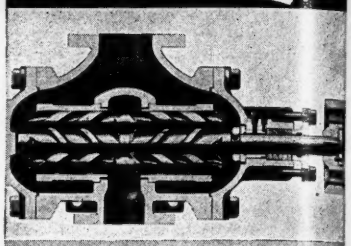
New Bulletin H-201 contains helpful handbook data on metal hose applications — ask for free copy.

THE INVISIBLE CREW Bendix AVIATION CORPORATION

Dept. 19—Phila. Div.—Philadelphia, Pa.

ECLIPSE *Seamless* **METAL HOSE**

TO KEEP NOISE *OUT* – PUT IMO *IN*



Where quiet, vibration-free pumping is essential, use an IMO . . .
made for
handling oils and other liquids
at all capacities and pressures

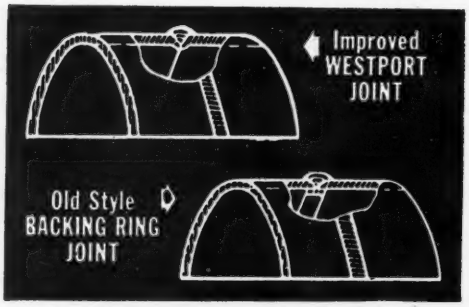
1-127

For information send for Catalog I-127C

IMO
PUMP DIVISION OF THE
DE LAVAL STEAM TURBINE CO
TRENTON 2, NEW JERSEY

I MOVE OIL

This Welded Joint



Eliminates Protrusions in pipes!

The Westport Patented Welded Joint provides a smooth pipe contour at the base of every weld.

There are no "icicles" . . . no protrusions!

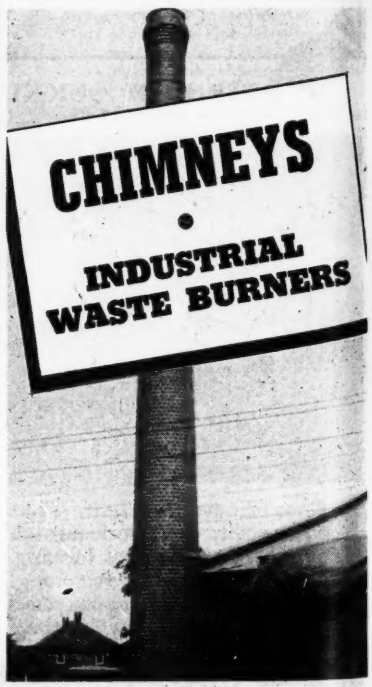
This new method, especially suitable in the welding of heavy wall piping for high-pressure-temperature conditions, is proving satisfactory in lines operating at 1250 pounds per square inch and 925 degrees F. total temperature steam service.

Mitchell's service includes this Westport method, which consists of the use of a joint in which the ends to be welded are formed and machined to provide a special U-shaped groove, joining the lips at the root of the weld by the oxyacetylene process and completing the joint by the usual electric arc procedure.

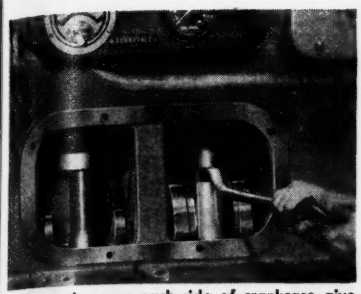
Important: With the Westport Joint, there's no sacrifice in the strength of the pipe due to removal of wall or Backing Ring . . . there are NO gaps between rings and inside of the pipe wall . . . and there's greater flexibility in alignment of pipe, valves and fittings!

WRITE WITHOUT DELAY FOR FULL DETAILS

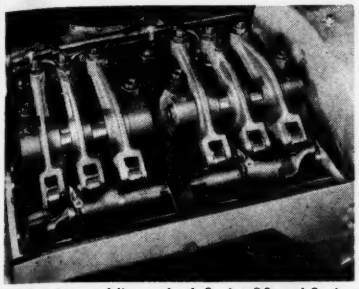
W. K. MITCHELL & CO., Inc.
PHILADELPHIA 46, PENNA.
1899 — 1945



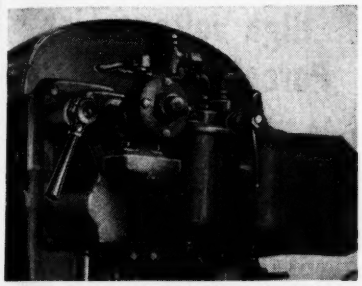
AMERICAN CHIMNEY CORP.
143 Fourth Ave., New York 3, N. Y.
BRANCHES: BOSTON • PHILADELPHIA
CLEVELAND • DETROIT



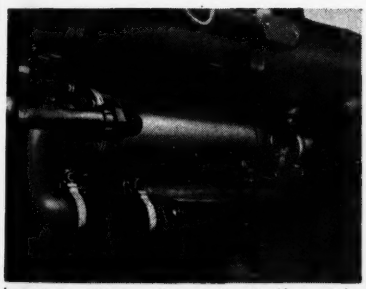
Inspection doors on each side of crankcase give ready access to main and crankpin bearings.



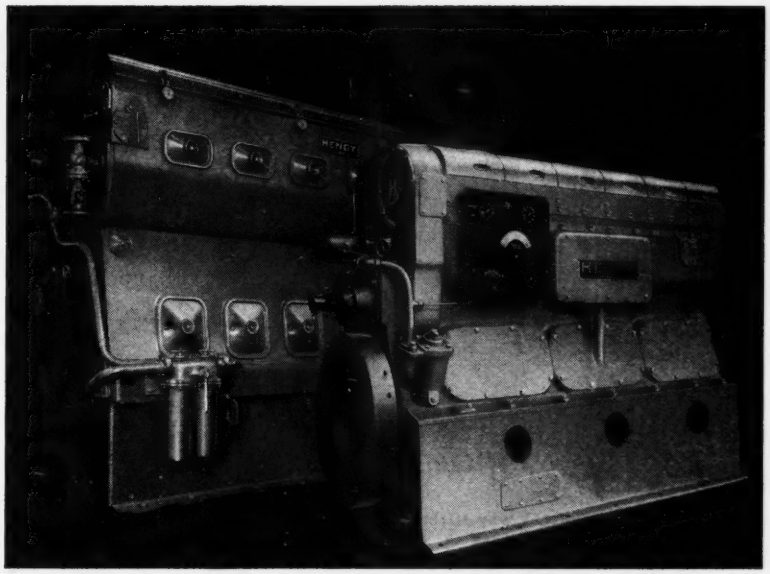
Overhead assemblies on both Series 20 and Series 50 Hendy Diesels are easily accessible.



Accessories may be individually serviced without disturbing any other assembly.



Inspection points on the engine itself may be reached without removing any of the accessories.



IN EVERY MODEL... ranging from 125 to 800 H.P.

Accessibility SIMPLIFIES OPERATION OF HENDY DIESELS

Hendy Diesels are designed to make inspection and servicing as simple as possible. Operators' problems were considered *first* in the design of all models of Hendy Diesels . . . with no concessions to the use of obsolete designs, practices, patterns, or tooling.

1. Large, easily removed inspection doors on each side of the engine give immediate access to all main and crankpin bearings for inspection or rapid servicing. Accessories need not be removed to open these doors.

2. Cylinder-head covers open conveniently, so the operator may easily inspect or service the overhead camshaft, rocker arms, valve mechanisms, and the modern unit-type fuel pumps and injectors.

3. Water and lubricating-oil pumps, governor, and other accessories are easy to reach without disturbing any other assembly . . . each is placed to allow ready access to any other vital part of the engine . . . yet all are placed to maintain the trim lines characteristic of all Hendy Diesels. Exposed piping has been eliminated wherever possible.

Every Hendy Diesel operator enjoys these time and money-saving features. Let Hendy Diesel power simplify your operating problems too. Clip and mail the coupon below today for complete details.

GENERAL SPECIFICATIONS—HENDY STATIONARY DIESELS

Air-starting. Optional equipment includes: Clutch power take-offs from either end; Engine-driven starting-air compressor; Closed-circuit cooling systems.

SERIES 20 & 30—125-265 hp; 600-900 rpm. **SERIES 50 & 60**—350-800 hp; 350-514 rpm.

Also available with generators from 75 to 500 kw.

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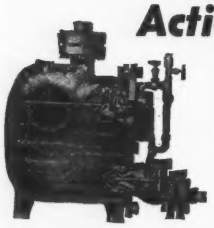
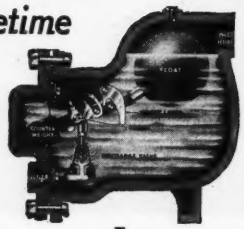


to Promote Peacetime Production Efficiency



Here are four big reasons why Nicholson Traps won highest honors for "standing up to their jobs" under the punishing tests of forced wartime production—and why they're a "must" for the efficient and economical solution of peacetime plant maintenance problems: (1) Greater drainage capacity. (2) Advanced trouble-free design. (3) Fast, positive action. (4) Greater efficiency, repeatedly proved by plant records.

For EVERY POWER AND PROCESS PURPOSE
Catalog 444 or See Sweet's

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GUARD AGAINST ENGINE BREAKDOWN from:

1. EXCESSIVE TEMPERATURE OF CIRCULATING-WATER SYSTEM
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WRITE FOR DATA SHEETS M-3 and M-3B

Every diesel and gas engine should be properly protected with a Viking alarm system. Viking is a complete system, no extras to buy. When water temperature becomes too high or oil-pressure too low, howler sounds to warn operator of danger. Type M-3B provides visual indication of source of trouble, also Heavy-duty construction, factory-set for your own requirements.

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Cleaning High Voltage Line Porcelain Insulators

As a result of long exposure to the elements, porcelain and similar type insulators on power transmission lines acquire deposits such as soot, iron and coal dust, chemicals and various other films. Under certain conditions these built-up films are potential sources of flash-overs and short circuits.

Eventually insulators have to be removed and replaced. Practice of many utility companies is to clean and recondition them by various methods. Depending on nature of deposits on surfaces, a one-step or two-step Oakite method will effectively remove them in most cases. Either manual or tank procedures may be employed.

Demonstration Gladly Arranged

Oakite Technical Service Representatives will gladly share their experience with you so as to help you handle this work on a satisfactory, low-cost basis. Inquiries invited and promptly answered.

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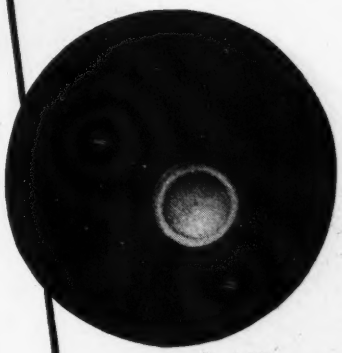
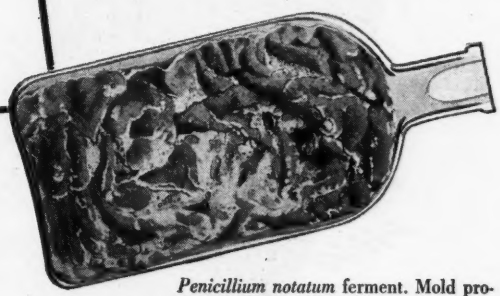
HELP MAKE AVIATION GASOLINE, SYNTHETIC RUBBER—AND NOW

PENICILLIN!



Penicillium notatum spore magnified 13,300 diameters.



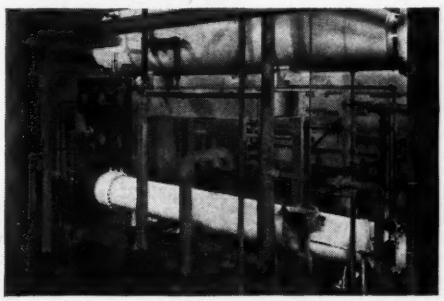
Penicillium notatum ferment. Mold produces crude penicillin. This process is carried on in huge tanks.

As THE accompanying illustration shows (Fig. 3), concentrators, built by ALCO for the important installation here pictured, in the plant of one of this country's biggest producers of penicillin, are playing an essential part in supplying this miracle drug to the armed forces and to America's hospitals.

Here, as in many other vital applications, ALCO Clamp-Ring construction ensures joints that are tight under extreme ranges of temperature and pressure, yet are capable of quick dismantling and assembly. They are, therefore, particularly advantageous in modern process and power equipment.

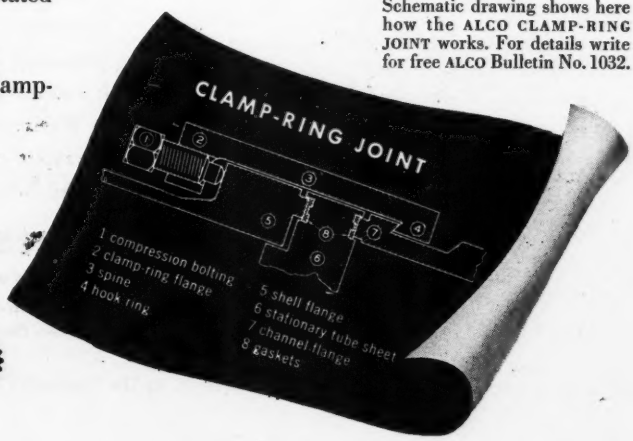
Of course, the pressures and temperatures involved in refining penicillin are not extreme. But, as stated above, this is a case of nothing but the best.

For complete information regarding ALCO Clamp-Ring Joints, write for Bulletin No. 1032.



The crude penicillin is purified in mass-production concentrating and extraction equipment. ALCO CLAMP-RING JOINTS installed in such equipment can be seen in this picture.

Schematic drawing shows here how the ALCO CLAMP-RING JOINT works. For details write for free ALCO Bulletin No. 1032.



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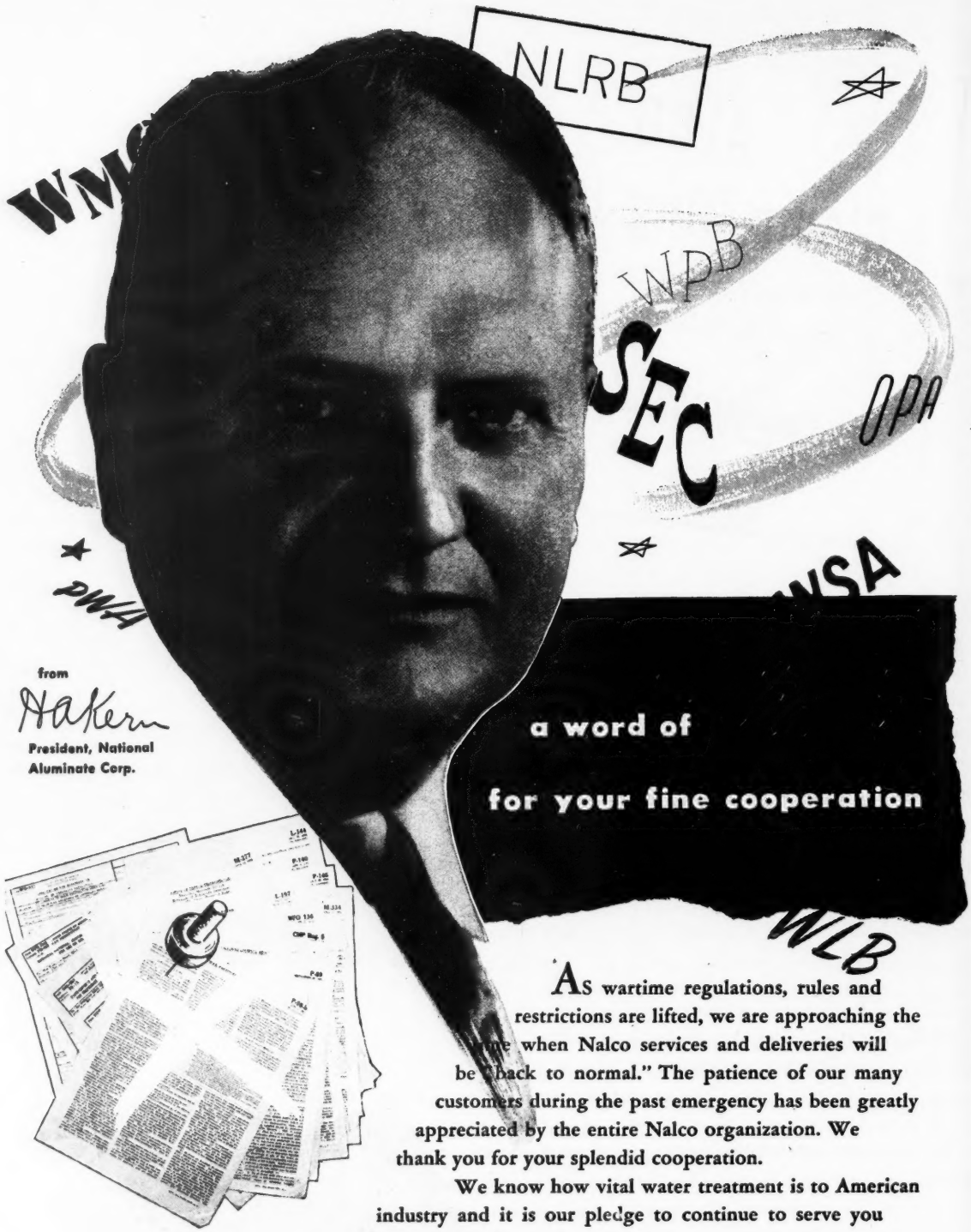

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Harkern
President, National
Aluminate Corp.

a word of

for your fine cooperation

As wartime regulations, rules and restrictions are lifted, we are approaching the time when Nalco services and deliveries will be back to normal." The patience of our many customers during the past emergency has been greatly appreciated by the entire Nalco organization. We thank you for your splendid cooperation.

We know how vital water treatment is to American industry and it is our pledge to continue to serve you always to the best of our ability.

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Nalco

HELPFUL BULLETINS

Answers to many operating and maintenance problems will be found in these new bulletins and catalogs. List paragraph numbers of those you want on coupon below, detach and mail.

BOILER PLANT

1 **Pneumatic Spreader Firing** — Latest bulletin on Iron Fireman pneumatic spreader stoker contains full descriptions, capacities, operating data, with layouts and photos of ten actual installations. Iron Fireman Mfg. Co.

2 **Packaged Steam**—Complete details of oil-fired packaged steam generating units of the self-contained automatic and semi-automatic types for boiler capacities ranging from about 350 lb of steam per hr to as much as 2250 lb of steam per hr, for small industrial steam generating applications completely described and illustrated in pamphlets No. 502, 503 and 504 just issued. The steam generating units are of the continuous tube water tube type designed to meet all ASME code requirements and built for operation at any desired pressure from 75 to 300 psi. Vapor Car Heating Company.

3 **Fuel Oil Diagnosis Chart**—Oil burner and Diesel operators can now avail themselves of a new advisory service for cleaning up operating difficulties and improving efficiency. This service is rendered by a free Diagnosis Chart developed by the Combustion Utilities Corp. Through this chart the Company makes recommendations, without cost or obligation, to help solve your particular problem.

4 **Flue Gas Dedusting** — Photographs and diagrams in new booklet on Diamond Deduster show modern methods of eliminating fly ash, cinders and other solids from flue gases. Tables also give water requirements, test results in typical plants, etc. Diamond Power Specialty Co.

5 **Coal Crusher Data**—Special features of American Rolling Ring and hammermill crushers, grinders and shredders which will help solve your coal crushing problems are presented in a new bulletin by the American Pulverizer Co. The Crusher size, horse power, speed, weight and floor space required for producing a uniform product at specified capacities is charted for coal, limestone and metal turnings. The chart shows specifications for bituminous coal as well as production for domestic stoker sizes or commercial screenings. All crushers are illustrated, and a cross section view shows the rigid construction and operating features of the Rolling Ring Crusher originated and manufactured by the American Pulverizer Company.

6 **Coal Storage**—Tractor Div, Allis-Chalmers Mfg Co. 8-page booklet gives advantages of the tractor, scraper and bulldozer for storing and handling coal.

7 **Glazed Refractory Coating**—A new bulletin Brickseal Refractory Co., describes Brickseal refractory coating which is applied to refractory brickwork or plastic refractories by paint brush or spray gun. Composed of high-fusion clays and metal oxides combined in oils, Brickseal fuses under heat to form a highly-glazed, monolithic protective coating over the entire refractory structure. Helps eliminate cracking and spalling of brickwork, stops infiltration of outside air, simplifies removal of slag and clinker.

ELECTRICAL

8 **Small Capacity and Synchronous Motors**—New 16 pg booklet carries plenty of performance curves, tables and pictures on R & M small capacitor and synchronous motors. Come in variety of convenient mechanical forms; all exactly interchangeable. Robbins & Myers, Inc.

9 **Unitized Switchgear**—New booklets on Unitized switchgear are said to save 30 per cent of usual time required to order, build and install switchgear. Also contain many pages of factual easy-to-use switchgear information. Westinghouse Electric Mfg. Co.

10 **Hints on Wiring Maintenance** — A practical working program to keep your electrical system in condition is outlined in a Preventative Maintenance book issued by Anaconda Wire & Cable Co. Also contains wiring diagram symbols, hints on motor selection, routine tests, etc.

11 **Protected Type Motor**—A new Protected-Type motor, designed for both drip-proof and open motor applications, is described in a bulletin by the Crocker-Wheeler Div. of Joshua Hendy Iron Works. Cutaway view of the motor, illustrating the various design features, is included to show how this construction provides protection against many of the common operation hazards.

12 **Alloys For Electrical Equipment**—Bulletin No. 158 describes "Callinite," a high conductivity alloy facing material for high current applications where pitting, sticking or welding of contacts may occur. Also suitable for facing arcing tips on air circuit breakers, heavy duty circuit breakers, motor controllers, heavy duty relays, industrial control contacts. Pictures the various types of Callinite: Type TC, a tungsten-copper alloy; Type ST, a tungsten-silver alloy; available in rods, squares and rectangles, and inserts.

FANS, PUMPS, COMPRESSORS

13 **Valveless Rotary Pump**—Bulletin describes the Vapiro Piston Rotary Pump built without valves, gear or springs. This combined form of rotary and reciprocating pump is being used for vacuum, liquid transfer, boiler feed and general service; capacities 1 to 100 gpm. O. S. Johnson.

14 **Air Compressors**—Attractive 48 pg book, printed in 4 colors, describes the complete line of Schramm stationary and portable air compressors. Covers trailer, four wheel, skid, crawler and rail-car mountings; contains compressor and engine specifications and other useful data. Schramm Inc.

15 **Porcelain Plungers For Pumps**—A six page illustrated data sheet, No. 57-2, completely describing "Kosmos" Porcelain Plungers, which can be used on almost any hydraulic pump, up to 2000 psi, is now available from the Aldrich Pump Co. In addition to telling of the savings resulting from decreased wear on packings and increased operating efficiency, the data sheet gives complete construction details, specifications, types of service and purchasing information.

16 **Hydraulic Data Book**—Engineers and others concerned with the pumping of liquids will find answers to many pumping problems in book "Hydraulic Data" issued by Blackmer Pump Co. Covers viscosity of liquids friction losses in pipes, head and pressure equivalents, theoretical horsepower requirement tables and related information.

17 **Check Chart on Centrifugal Pumps**—How to check for the capacity, efficiency and head of your centrifugal pumps; suggested procedure for disassembly and inspection; tips on correcting for vibration and noise; and other reconversion data is published in a new Reconversion Inventory check chart. Allis-Chalmers Mfg. Co.

18 **Pipe Line Aftercoolers**—Booklet with sectional views and installation diagrams explains how Adams pipe line aftercoolers and cyclone separators remove condensed oil and water from compressed air lines. Easily installed in vertical or horizontal run of piping without extra valves. R. O. Adams Co., Inc.

INSTRUMENTS AND CONTROLS

19 **Temperature Controls For Tanks**—A new bulletin describing temperature controls for tank and process installations has just been released by Sterling, Inc. It contains complete data on sizes, capacities and temperature ranges as well as photographic illustrations and dimensional drawings

20 **Industrial Instrumentation**—New 48 pg handbook entitled "Foxboro Industrial Instrumentation" covers application and performance of instruments for indicating and controlling temperature, flow, pressure, liquid level, humidity. Includes many useful charts, tables, diagrams. The Foxboro Co

21 **Automatic Controls**—Catalog 600 describes the Mercoid line of automatic controls for regulating electrically operated equipment in accordance with changes in temperature, pressure, vacuum, fluid level or mechanical movement. Mercoid Corp.

22 **Control Valves For Molding Presses**—New Bulletin No. 645 entitled "Nicholson Control Valves and Steam Traps for Plastic Molding Presses" offers practical data on application, operation, construction, capacity, etc. W. H. Nicholson & Co.

23 **Boiler Room Instruments**—Catalog No. 16 pictures and describes Defender portable boiler room combustion test outfits, recording pressure and vacuum gauges, heating and air conditioning instruments, draft gauges and related equipment. Defender Instrument & Regulator Co.

24 **Governors For Hydro-Electric Units**—A 24 pg bulletin (B6356) on centralized control provided by modern governors for large hydro-electric units has been released by the Allis-Chalmers Manufacturing Co. Fully illustrated with governor and related hydraulic-turbine equipment photographs, diagrams, and figures, the bulletin defines the functions of governors and describes set-ups for Francis, Kaplan, and Pelton turbines. Described are Allis-Chalmers hydro-electric applications and governor arrangements at the Pickwick Landing plant, Kentucky power plant, Wilson Dam, and the Fontana plant of the Tennessee Valley Authority; the Alcoa Glenville plant of the Natahola Power and Light Company; and the Interior Department's Shasta Power plant. Concludes with a discussion of "Governor Operation in Practice" and a "Comparison of Governor Characteristics."

MAINTENANCE MATERIALS

25 **Packing Pointers**—Graton & Knight Co. offers in file size folder form a series of 12 articles, titled "Packing Pointers." It gives helpful information in selection of Cup, Flange, U, and Vee Packings. Also included is adequately illustrated text on the correct design of machine parts adjacent to mechanical packings.

26 **Heat Insulation Handbook**—176-pg. Heat Insulation Handbook describes Ehret's 85% magnesia and other heat insulating materials, both as to selection and application for boilers, steam lines, tanks, etc. Ehret Magnesia Mfg. Co.

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OCTOBER, 1945

POWER PLANT ENGINEERING

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27 **New Roof Coating**—A C Horn Co. 4-pg. booklet presents Hornlume, a material which contains asphalt and aluminum for roof protection.

28 **Armored Floors**—New folder "Dangerous Wet Floors" supplies detailed information on Stonhard Stonpack. Forms a coat of armor on surface of floor and withstands both abrasive wear and deterioration Stonhard Co.

29 **Free Repair Handbook**—Company offers free 40-pg. guide for the use of Smooth-On cements, containing 170 diagrams and instructions for making lasting and economical repairs to plant equipment and machinery, pipe lines, fixtures, etc. Smooth-On Mfg. Co.

30 **Buyers Data On Forged Gaskets**—"Gruv-Seal, Forged Iron and Alloy, Ring Gaskets" is the title of a new booklet published by the Steel Improvement and Forge Co. Gives complete information and buying data on forged gaskets made of ingot iron, nickel, chromium and monel metals. These gaskets are particularly suitable for high pressure and high temperature service.

31 **Waterproofing and Leak Sealing Compound**—Booklet describes compound that seals leaks against water pressure—waterproofs walls—seals concrete water tanks or vats. Comes in liquid form and, when added to concrete mortar, sets up quickly—protects against dampness and underground seepage. Flexrock Co.

MECHANICAL TRANSMISSION

32 **Fractional-Horsepower Drives**—Latest American Fractional - Horsepower Wedgbelt Drives Catalog contains complete price lists and specifications on the complete new line of F.H.P. Sheaves and Belts. Also includes 4 pages of condensed and simplified drive tables for a wide range of center distances and drive ratios. The American Pulley Co.

33 **Ready-To-Use Bushings**—New catalog describes Shook ready-to-use bushings and mechanical bronze bars made of a special phosphorized bearing bronze with an increased resistance to crushing strain, greater load-carrying capacity. Lists over 800 stock sizes. Special suggestions for machining and finishing are included. Shook Bronze Corp.

34 **Extensible-Tip Belt Splice**—A new bulletin describing the Manhattan Extensible-Tip splice and how it prolongs the life of Condor Endless Belts with Extended-Area Stress-Relief, has been issued by The Manhattan Rubber Mfg. Div. of Raybestos-Manhattan, Inc. This bulletin, which contains numerous endless belt installation photographs and schematic diagrams describing the splice, cites five advantages obtained in the use of the Manhattan Extensible-Tip.

35 **Tips On Gear Performance**—"Ampco Metal in Gears" is a 4-pg. bulletin describing the use of this aluminum bronze in gear applications, issued by Ampco Metal, Inc. Bulletin points out that common causes of gear trouble are breakage, deformation, wear or flaking and pitting of the teeth, whereas Ampco metal's high tensile strength, yield strength and elongation aid in eliminating breakage encountered in weaker bronzes.

36 **Reconversion Inventory of V-Belt Drives**—Handy check list for each machine shows: 1. Present condition of drive; 2. Condition of belts; 3. Condition of sheaves; 4. Drive engineering; 5. Belt engineering. Offers practical tips on correcting scuffing, slip burn, oil swelling and abrasion. Allis-Chalmers Mfg. Co.

PIPING, VALVES, FITTINGS

37 **Steam Hook-Up Book**—Many practical ideas on how to enlarge the capacity of steam heating lines and heating coils will be found in the Sarco Hook-Up book. Contains recommendations and sketches for fitting Sarco traps, strainers and other products into your plant operation. Sarco Co., Inc.

38 **Liquid Meter Valves and Slides**—New bulletin tells about self lubrication quiet operation, light meter valves and slides. Widely used for gasoline, chemical processing, corrosive liquid, acid and alkali valves. Morganite Brush Co.

39 **Expansion Joints**—Wide range of expansion joints for controlling low or high pressure steam, hot water, gasoline, oil, air, or other pipe lines is described in catalog No. 35 P. American District Steam Company.

40 **Corrosion and Abrasive Proof Diaphragm Valves**—Bulletin describes McAlear corrosion-proof diaphragm valve; Available in 10 sizes, ½ in. to 6 in. screwed or flanged, in semi-steel or lined with rubber, glass, or lead. Automatic Control Div., Climax Industries.

41 **Tube Cleaning Suggestions**—Correct steps in a tube-cleaning operation to insure highest efficiency are outlined in a new service bulletin by Thomas C. Wilson, Inc. Information covers selection of appropriate equipment, proper cleaning procedure, care of cleaning equipment, and listings of types and sizes of motors, cutters, brushes and other accessories.

42 **Spray Nozzle**—Handbook Yarway Bulletin N-616 lists advantages, spray characteristics, performance, dimensions and other handbook data on spray nozzles for water cooling, air conditioning and general industrial use. Yarnall-Wiring Co.

43 **Valves For Corrosion Resistance**—A new booklet, "Powell Valves for Corrosion Resistance," describes and illustrates a number of valves that are available in a wide selection of pure metals and special alloys for corrosion service. Includes various types of valves such as globe, angles, gates, checks, "Y's" needle, relief, flush bottom tank valves, etc., which can be made in materials to control the flow of practically any known corrosion media.

WATER TREATMENT

44 **All-Colloidal Water Treatment**—Bulletin No. 33 "The Modern Way To Avoid Boiler Troubles" describes the K.A.T. all-colloidal treatment which is said to yremove old scale by infiltration, prevent scale by coagulation, reduce corrosion by protective film formation. American Corp.

45 **Slime and Lime Control In Evaporative Condensers**—New field service report offers practical tips on treating cooling water with Oakite Airefiner No. 52; specially designed for use in Diesel and gas engines, cooling oil in power transformers, evaporative condensers and coolers. Oakite Products, Inc.

46 **Chemical Feeders**—Bulletin describes chemical feeders for automatic boiler feed water treatment. Installed on boiler pumps, they automatically feed a small amount of chemical into the line with each pump stroke Adjustable to exact requirements Manzel Brothers Co.

47 **Studies of Boiler Scale**—"Experimental Studies of Boiler Scale at 800 psi" is the title of a reprinted article covering tests of boiler feedwater treated with calcium, magnesium, silica, alumina, phosphate. Photos show deposits under various operating conditions. National Aluminate Corp.

48 **Chlorination of Condenser Waters**—Technical Reprint No. 474 includes a discussion of "Chlorination of Condenser Water" and "Characteristics of Microbiological Deposits in Water Circuits." Contains many photos and diagrams, references to many articles on water treatment and corrosion control Wallace & Tiernan Products, Inc.

MISCELLANEOUS

49 **Heat Stable Greases, Varnishes, Rubber**—New illustrated folder describes properties and applications of Dow Corning silicones as produced in greases, varnishes, sealing compound, rubber and fluids. In all forms the silicones extend permissible operating temperatures far above and below those at which comparable organic materials are serviceable. Dow Corning Corp.

50 **Oil Clarifiers**—Briggs Clarifier Co. Washington 7, D. C. 36-pg. booklet G, F, DFR, DR and DRU series oil clarifiers and ZR series oil filters. Article entitled "Continuous Lube Oil Maintenance," by Walter C. Bauer, is included in booklet.

51 **Multi-Purpose Grinder Attachment**—Illustrated folder tells how the insertion of the Strong grinder attachment you can make tapered plug gauges, "go" and "no go" gauges, tapers, die punches, reamers and other tools. Strong Manufacturing Co.

52 **Steel Work Bench**—Streamlined design, sturdy construction, and are features of the improved Equipto 12-gauge steel work bench described in new bulletin. Bench is suitable for both work bench use and for supporting light machine tools. The four feet have holes to permit fastening to floor if desired.

53 **Evaporators and Heat Exchangers**—Described in new 8 pg. bulletin are various types of evaporators, heat exchangers, extraction columns and other process equipment made by Union Iron Works. Diagrams show typical installations in process industries.

54 **Process Industry Equipment**—Solvent recovery tanks, manifold valves, deodorizer tanks, condensers and other equipment fabricated for the process industries are described in new 8 pg. folder. Contains flow sheets of typical Hicks installations. S. D. Hicks.

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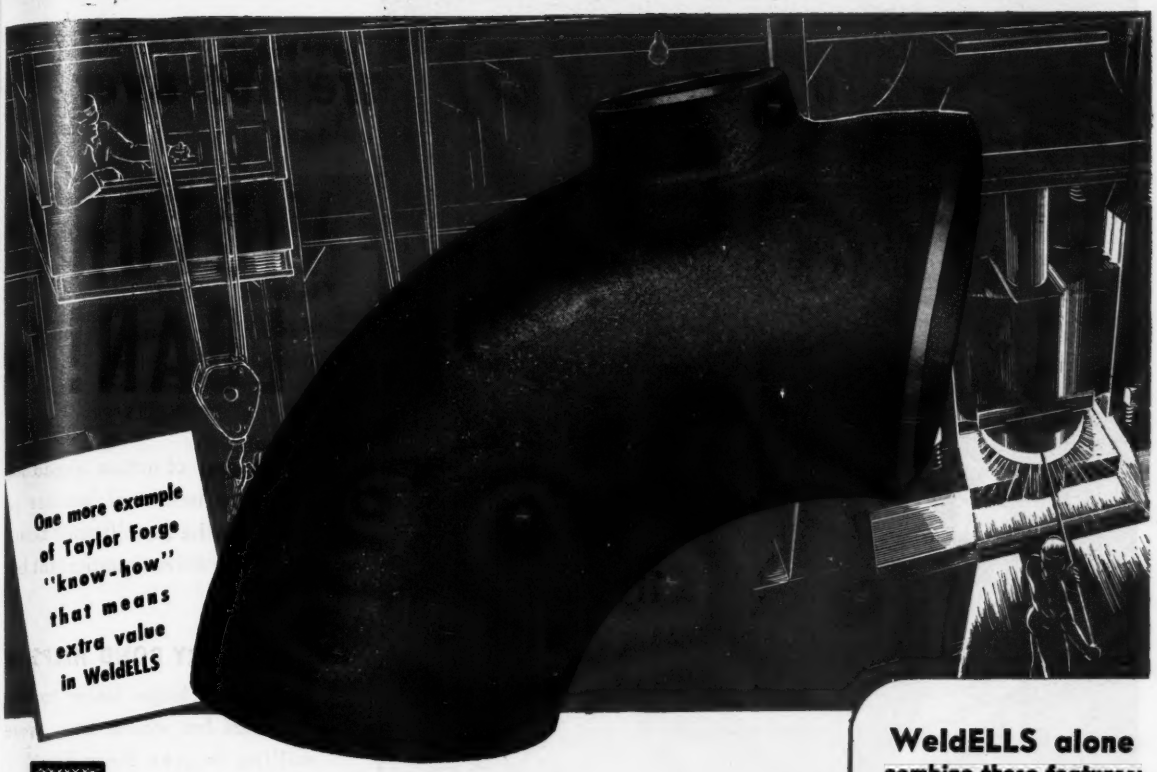
PHILADELPHIA 35, PA.

Branch Offices in Principal Cities



One more example of Taylor Forge "know-how" that means extra value in WeldELLS

There's always another one for us!

★ *Just when we think we've seen everything in special forged fittings another tricky requirement turns up . . . and probably always will. This time it's an order for seven-inch carbon-moly WeldELLS with integrally formed 3-inch outlets in their back walls.*

We have solved problems that are a lot tougher than this, but none exactly like it. Thus, like hundreds before it, it has contributed its share to the sum total of Taylor Forge "know-how" . . . is one more proof that we have honestly earned our reputation for doing things with hot metal no one else does.

THE unduplicated experience of Taylor Forge in the field of special forging has a vital bearing on your choice of standard welding fittings. It means there is nothing to be desired in welding fittings that is not within the scope of the methods and facilities that have grown out of this experience.

By applying these methods and facilities we have given WeldELLS features that are not combined in any other fittings. A good example of this is the uniform strength achieved through proper distribution of extra metal where stresses are higher. Another, is the extreme dimensional accuracy attained by special truing operations. Still another is the special process which forms the tangents, and there are many more.

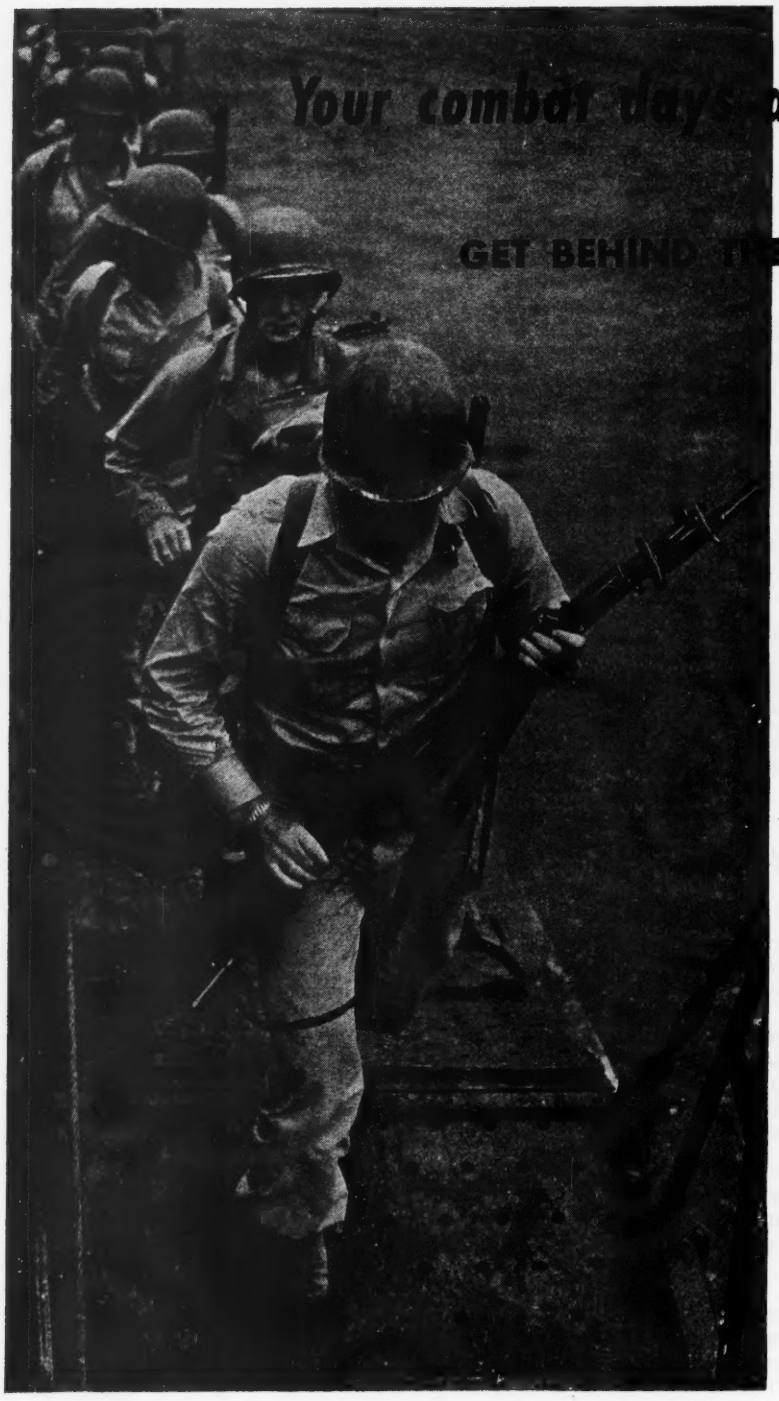
This specialized Taylor Forge knowledge is responsible for the features listed opposite—is the reason why those who are best qualified to know will agree that

WeldELLS alone combine these features:

- **Seamless** — greater strength and uniformity.
- **Tangents**—keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends**—simplify layout and help insure accuracy.
- **Selective reinforcement** — provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum**—assures full strength and long life.
- **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World** — insures complete service and undivided responsibility.

WeldELLS have everything

TAYLOR FORGE & PIPE WORKS, General Offices & Works: Chicago, P.O. Box 485
New York Office: 50 Church Street • Philadelphia Office: Broad Street Station Bldg.



VICTORY LOAN!

There's plenty of action ahead for fast-thinking industrial leaders in putting over the new Victory Loan! Your Victory drive is important because:

EVERY VICTORY BOND HELPS TO

1. **Bring our boys back to the America for which they were willing to give their lives!**
2. **Provide the finest of medical care for our wounded heroes!**

BOOST THE NEW F. D. ROOSEVELT MEMORIAL $200 BOND!

Urge all your employees to buy this new Franklin Delano Roosevelt Memorial $200 Bond through your Payroll Savings Plan! At all times better than ready cash, Victory Bonds are industry's "Thanks" to our returning heroes!

START YOUR VICTORY DRIVE TODAY!

Every Victory Bond aids in assuring peacetime prosperity for our veterans, our nation, your employees—and your own industry!

The Treasury Department acknowledges with appreciation the publication of this message by

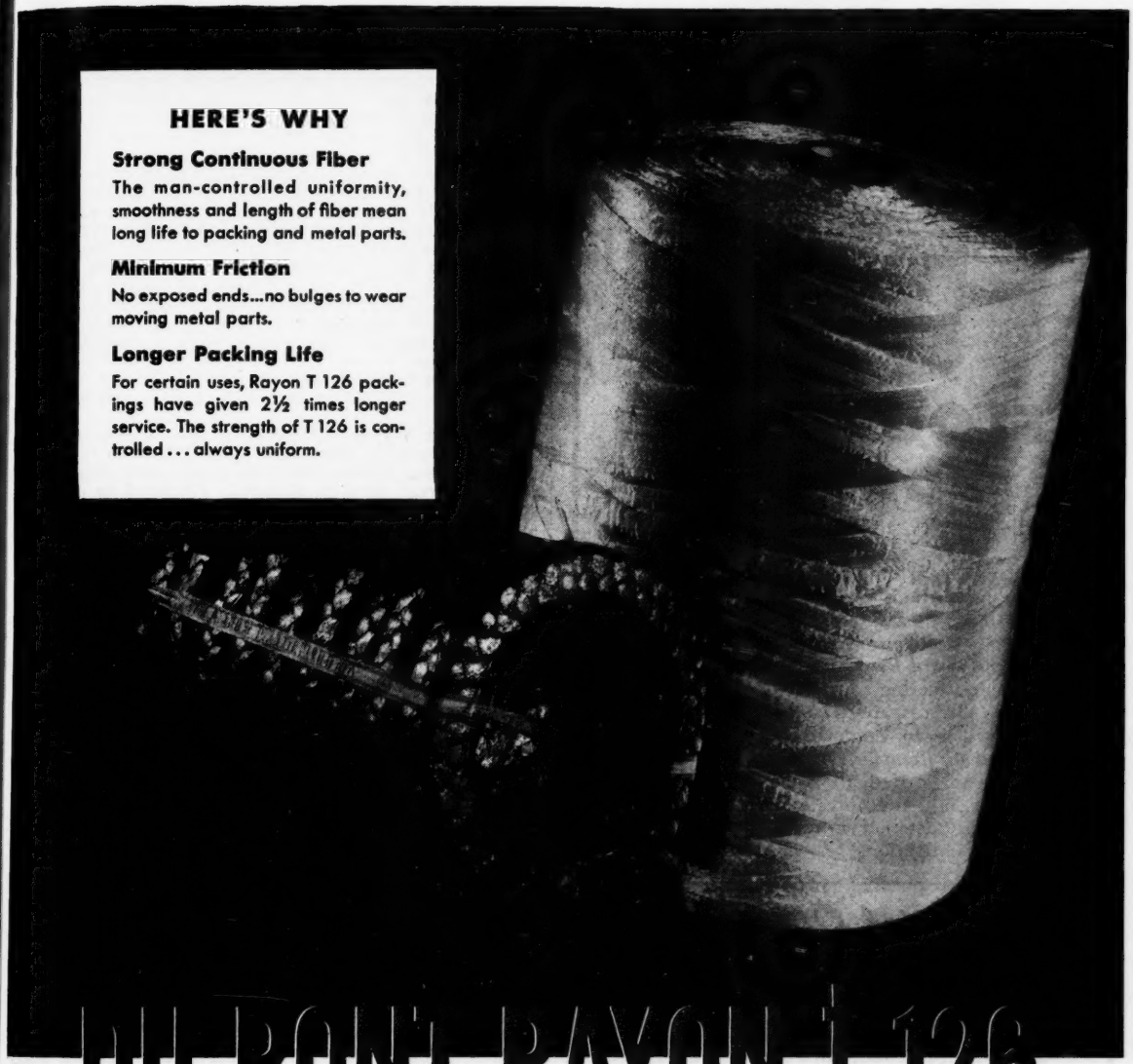
VICTORY LOAN

POWER PLANT ENGINEERING

★ *This is an official U. S. Treasury advertisement prepared under the auspices of the Treasury Department and War Advertising Council*

Du Pont Recommends Rayon Fiber Packing

(ALL LEADING PACKING MANUFACTURERS CAN SUPPLY IT)



HERE'S WHY

Strong Continuous Fiber
The man-controlled uniformity, smoothness and length of fiber mean long life to packing and metal parts.

Minimum Friction
No exposed ends...no bulges to wear moving metal parts.

Longer Packing Life
For certain uses, Rayon T 126 packings have given 2½ times longer service. The strength of T 126 is controlled . . . always uniform.

DU PONT RAYON T 126

the precision packing fiber

Ask your suppliers for hydraulic packings fabricated of this new man-made, man-controlled fiber—Du Pont Rayon T 126. Developed to meet wartime needs, it has proved superior to top grade fibrous packing for many uses.

New uses are developing steadily. Already, Rayon T 126 is used for service against cold or hot water and brine in pump rods, plungers, rams, elevator plungers, accumulators, centrifugal and reciprocating pumps.

All leading manufacturers are ready to ship packings made of Du Pont Rayon T 126. It's the coming thing in the fibrous packing field for many uses. Order a trial run from your packing supplier. Use as he recommends.

DU PONT
REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING
...THROUGH CHEMISTRY

Rayon Department, E. I. du Pont de Nemours & Co. (Inc.) . . . Wilmington 98, Delaware

FLOORS *by the* DRUM

IF your floors need resurfacing because they are broken and worn . . .

. . . All you have to do is get *Stonhard Resurfacer*, follow the instructions for its application that comes with each shipment, and you can once more have floors that will "take" heavy trucking and traffic.

Because *Stonhard Resurfacer* does away with chopping or air-hammering concrete, ripping up wood or composition surfaces, and is easy to apply, any handyman can put it down. Production need not be tied up, because *Stonhard Resurfacer* takes only 36 hours to dry.

Take advantage of this one easy way to rid your floors of ruts, holes and breaks. Mail the coupon below for more detailed information. There is no obligation.

Here's the *Trial Offer*

A drum of *Stonhard Resurfacer* will be sent on trial to any responsible company. A portion of this material may be used to repair ruts, holes and breaks, or to resurface those portions of your floors that are under constant trucking and traffic. If not satisfactory after 30 days use and observation, our invoice will be cancelled.

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Building Maintenance Materials

Serving the Railroads, Public Utilities and Industries Since 1922

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STONHARD COMPANY
811 Terminal Commerce Bldg.
Philadelphia 8, Pa.

Please send us more details on *Stonhard Resurfacer*.

Our floors are Concrete.....Wood.....Brick.....Composition....

FIRM.....

MR.....TITLE.....

ADDRESS.....

CITY.....ZONE.....STATE.....

POWER PLANT *Construction News*

Calif., San Francisco—Crown Cork & Seal Corp., 25th St. and Potrero Ave., metal bottle seals, bottling and capping machinery, plans installation of electric power equipment in new additions to plant, comprising several one-story units. Entire project will cost about $3,000,000. Main offices are at Eastern Ave. and Kresson St., Baltimore, Md.

Ga., Macon—Mead Corp., Chillicothe, Ohio, paper and paper board products, plans installation of electric power equipment in proposed new pulp and paper mill near Macon, where site is being selected. It will comprise several large units, equipped for initial rating of 500 tons of paper board daily. A power plant and pumping station are planned. Entire project reported to cost close to $10,000,000. George F. Hardy, 441 Lexington Ave., New York, N. Y., is engineer.

Ill., Edwardsville—Board of Madison County Commissioners, Court House, Edwardsville, is considering new steam power house at local County Sanitarium, reported to cost over $175,000, with boilers, pumps and auxiliary equipment.

Ind., Fort Wayne—Cooperative Milk Producers, Inc., 340 East Berry St., plans boiler plant, 60 x 65 ft, at new milk receiving station on State road, near city, entire project to cost close to $100,000. Proposed to ask bids soon. A. M. Strauss, Cal-Wayne Bldg., Fort Wayne, is architect.

Ind., New Albany—Gunnison Homes, Inc., New Albany, fabricated metal houses, a subsidiary of U. S. Steel Corp., New York, N. Y., plans installation of electric power equipment in new local plant, consisting of several one-story units, with facilities for large output. Cost reported close to $1,000,000, with machinery. Work is scheduled to begin soon. Foster Gunnison is president.

Ky., Frankfort—National Distillers Products Corp. plans improvements in power plant at local whiskey distillery, including installation of coal storage and handling equipment, track hopper, screw conveyor and other equipment. Cost reported over $100,000. Work is scheduled to begin soon. Main offices are at 120 Broadway, New York, N. Y.

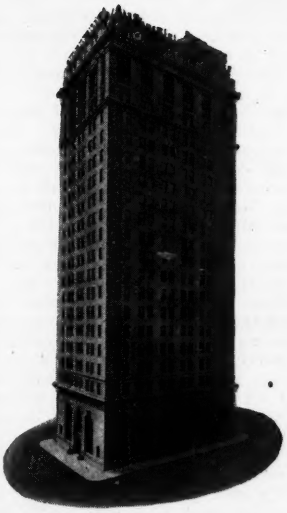
Mich., Lansing—Board of Water and Electric Light Commissioners, Lansing, has plans nearing completion for expansion in municipal steam-electric generating station, including installation of new turbine-generator unit, high-pressure boiler and auxiliary equipment. Cost reported about $4,000,000. Burns & Roe, Inc., 233 Broadway, New York, N. Y., is consulting engineer.

Mich., Port Huron—Detroit Edison Co., 2000 Second Ave., Detroit, Mich., will make extensions in Marysville steam-electric generating station, near Port Huron, in connection with general expansion and improvement program now being arranged, to cost about $4,000,000 over a period of several months. Installation will include a new 100,000-hp turbine-generator unit, high-pressure boiler and auxiliary equipment. Completion is scheduled in about 12 months. Extensions will be made in transmission lines in that area.

Mo., Slater—Municipal Utilities Department plans extensions and improvements in municipal power plant, including installation of additional equipment. A bond issue of $80,000 is being arranged.

N. H., Keene—E. F. Timme & Son, 1 Park Ave., New York, N. Y., plushes, velour, etc., plan new mill on Marlboro St., Keene, where tract of about 75 acres of land is being secured. It will comprise several one and multi-story buildings, equipped for large capacity. Electric power equipment will be installed. A boiler house is planned. Entire project is reported to cost over $1,500,000.

N. J., Cranford—Johnson & Johnson, 500 George St., New Brunswick, N. J., surgical dressings, medical preparations, etc., plans installation of electric power equipment in new plant on Walnut Ave., Cranford, where site was acquired a number of months ago. It will comprise a main one-story building and auxiliary structures, reported to cost over $250,000. A boiler house is planned. Work scheduled to begin soon. The Ballinger Co., 105 South 12th St., Philadelphia, Pa., is architect and engineer.



First National Bank, Baltimore, Maryland.

MORE SERVICE... with FEWER elevators

THE First National Bank Building of Baltimore, Maryland is another of the many buildings in which elevator modernization by Otis resulted in better service at less operating cost.

Originally, this building was equipped with six Car Switch Controlled Gearless Elevators. All six elevators had to be operated to handle the building traffic.

These elevators were changed over to Otis Peak Period Control and now only five elevators are required to handle the traffic during the morning, noon, and evening peaks. For the normal traffic requirements only four elevators are required.

Whatever your transportation problems . . . regardless of the height or type of your building . . . your Otis representative is ready to consult with you or your Architect.

For the finest in vertical transportation tomorrow, call your Otis representative TODAY.

Partial view of 1st Floor lobby showing elevator entrances.

Partial view of the Penthouse Machine Room after Otis Modernization.

Otis ELEVATOR COMPANY
OFFICES IN ALL PRINCIPAL CITIES

Davis No. 14 direct connected spring loaded regulator for steam, air, gas, water, oil.

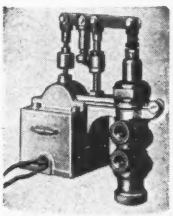
LIQUID LEVEL CONTROLS

Float Boxes, Float and Lever Tank Units, Float and Lever Operated Valves and combinations of these units to meet any service conditions. Available with Davis Dia-Ball packless, leakproof transmission.

Davis No. 161D Packless Float Box and No. 66B Packless Control Valve.

SOLENOID VALVES

Davis Solenoid Valves handle viscous liquids, steam, oil, gas, caustic chemicals — *any* liquid or gas safely and efficiently. Exclusive Dia-Ball packless, leakproof transmission where required. Sizes ½" to 12". Pressures to 1500 lbs.



Davis No. 380 3 or 4-way pilot valve used on air or liquid actuated power cylinders.

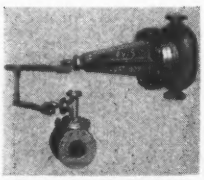
PRESSURE REGULATORS

A complete line of 18 different types for steam, air, gas, water and oil. Sizes to 24". Pressures to 1500 lbs.

Davis No. 80 noiseless, semi-balanced back pressure valve for exhaust lines. Sizes 2" to 24".

RELIEF VALVES

For pressure relief to atmosphere or to low pressure lines, vacuum relief, pump by-pass and protection of equipment. The No. 265 Relief Valve can be equipped for hand testing and manual control.



Davis No. 60 Single Seat Balanced Float Valve. Maintains desired liquid level automatically.

BALANCED VALVES

There's a Davis Balanced Valve for any flow control problem, regardless of type of fluid, pressure, etc. Available with Dia-Ball packless, leakproof transmission. Sizes ½" to 24".

DAVIS REGULATOR CO.

2508 S. Washtenaw Ave., Chicago, Ill.

Above are typical Davis automatic valve specialties. Bulletins giving complete description available upon request—and you can be sure that the valves Davis recommends will do the job to your complete satisfaction.

DAVIS REGULATOR COMPANY

N. Y., Buffalo — Board of Erie County Supervisors, County Hall, Buffalo, is considering extensions and improvements in power plant at County Penitentiary, including installation of new boilers and other equipment. Cost estimated over $500,000. County engineer will be in charge.

N. Y., Central Islip—State Department of Mental Hygiene, State Office Building, Albany, N. Y., has plans under way for new power plant at State Hospital at Central Islip, reported to cost over $1,500,000, with equipment, including service connections, etc. Louis A. Abramson, 25 West 45th St., New York, N. Y., is architect.

N. Y., Staten Island—Staten Island Edison Corp., 50 Bay St., Richmond, has plans in progress for extensions and improvements in main generating station at Livingston, with installation of equipment for increased capacity. No estimate of cost announced. Gilbert Associates, Inc., 412 Washington St., Reading, Pa., is consulting engineer.

N. C., Lenoir—Spainhour Furniture Co., Lenoir, plans boiler house in connection with new factory on 11-acre tract of land near city. Electric power equipment will be installation for plant service. Entire project will cost approximately $100,000. Work is scheduled to begin at early date.

Ohio, Massillon—Massillon Aluminum Co., aluminum cooking utensils, plans installation of electric power equipment in new one-story addition for manufacture of stainless steel products. Cost estimated about $300,000, with machinery. Proposed to begin work at early date.

Okla., Harrah—Oklahoma Gas & Electric Co., Oklahoma City, Okla., has approved plans for immediate construction of outdoor-type addition to Horseshoe Lake steam-electric power station, near Harrah. Installation will include a 10,000-kw generator with accessories, high-pressure boiler and auxiliary equipment. Cost reported close to $2,000,000, including transmission line extensions.

Tenn., Memphis—Light, Gas & Water Department, 179 Madison Ave., is arranging fund of $2,000,000 for expansion and improvements in municipal electric properties during next 24 months. Program will include two new power substations in different parts of city, each to cost ported to cost about $1,500,000.

Texas, Freeport—Dow Chemical Co., Texas Division, Freeport, industrial and other chemicals, has authorized expansion and improvement program at local plant, to be carried out over period of several months. Work will include number of new buildings, with machinery and facilities for large increased capacity. Electric power equipment will be installed. Entire project estimated to cost about $15,000,000. Main offices are at Midland, Mich.

Va., Richmond—Philip Morris & Co., Ltd., 10 South 20th St., plans installation of electric power equipment in proposed new multi-story addition to cigarette factory. Also will make extensions in power plant, with additional equipment for increased capacity. Entire project is re- approximately $500,000,

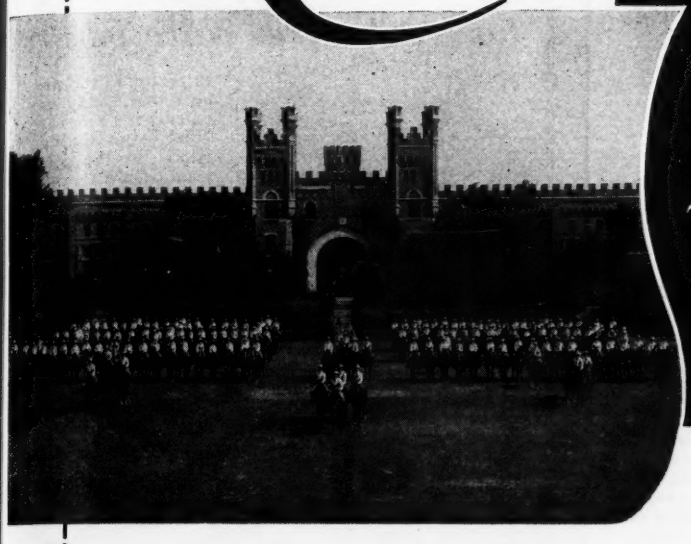
W. Va., Weirton—Continental Can Co., Inc., 100 East 42nd St., New York, N. Y., has acquired tract of about 145 acres of land at Weirton as site for new tin-can manufacturing plant. It will comprise several large one and multi-story buildings, equipped for heavy output. Electric power equipment will be installed. A power plant is planned. No official estimate of cost announced, but reported in excess of $2,500,000. Construction will begin at early date.

Wis., Genoa—Dairyland Power Cooperative, Genoa, has plans under way for new generating station near Genoa, supplementing present station, estimated to cost about $1,250,000. Financing in that amount has been arranged through Federal aid. Vern E. Alden, 120 South LaSalle St., Chicago, Ill., is consulting engineer.

Wis., La Crosse—Northern States Power Co., La Crosse, has plans under way for addition to local French Island steam-electric generating station, with installation of additional equipment for increased output. Cost estimated about $1,285,000. Application has been made to State Public Service Commission for permission to proceed with work. Public Utility Engineering & Service Co., 231 South LaSalle St., Chicago, Ill., is engineer.

Wis., Milwaukee — Blatz Brewing Co., 1120 North Broadway, subsidiary of Schenley Distillers Corp., 350 Fifth Ave., New York, N. Y., plans installation of electric power equipment in new five-story bottling plant and for other service in connection with expansion and modernization program in brewery. Boiler plant will be increased. Entire project reported to cost close to $3,500,000. Carl J. Kiefer Associates, Inc., 26 East Sixth St., Cincinnati, Ohio, is consulting engineer.

AT CULVER



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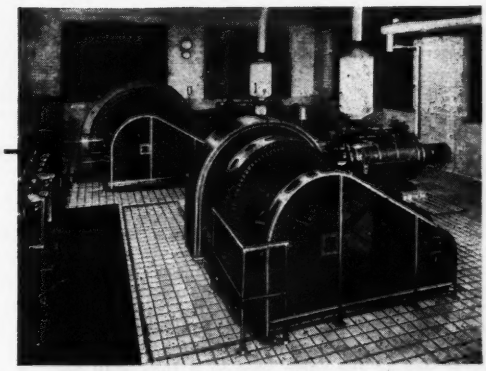
"Fit for the citizenship of the morrow"

SKINNER "UNIVERSAL UNAFLOW" STEAM ENGINES

Generate dependable, economical Electric Power . . .



The two horizontal "Universal Unaflow" Engines, with 312-kv.a. and 500-kv.a. Generators, in the Culver power plant

CULVER'S foundations were laid by men of courage, sincerity and vision. Founded in 1894 by Henry Harrison Culver, it has grown to be one of the great schools of America. Its grounds comprise 1000 acres on the shores of beautiful Lake Maxinkuckee in northern Indiana. Culver's students are trained in character, physical stamina and courage for positions of leadership in public and private life.

Two Skinner "Universal Unaflow" Steam Engines are a definite part of this great institution. They, too, have the stamina and the ability to stay on the job, whether the assignment is easy or tough; to offer no complaint when extra demands are made, and to generate dependable, economical electric power, with exhaust steam available for heating the twenty-three buildings.

The leadership of Skinner Engine Company and the "Universal Unaflow" in the steam engine field is generally recognized by power users, as evidenced by the many industries and institutions of various types in which they are installed.

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For Over 75 Years Doing One Thing Well—Building Steam Engines

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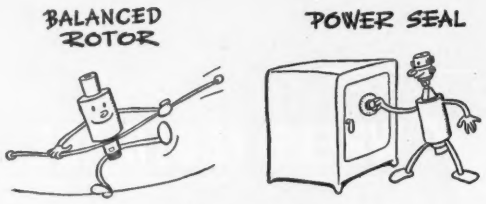

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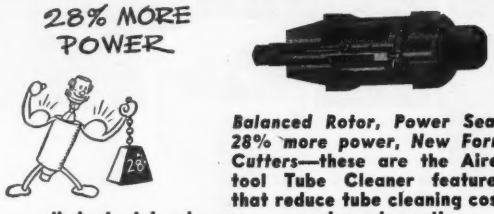
CUT TUBE CLEANING COSTS

Less Down Time! No Tube Damage!



Balanced Rotor, Power Seal, 28% more power, New Form Cutters—these are the Airetool Tube Cleaner features that reduce tube cleaning cost . . . eliminate tube damage . . . reduce down time.

The Balanced Rotor in Airetool's powerful motor eliminates friction so that all power is directed against the load. The *Power Seal* feature stops power waste in the operation of the motor and produces constant torque at low speeds, eliminates dead centers and allows the motor to be loaded to 50 rpm without stalling. Motor picks up immediately when load is released. As the result of the features of Airetool motors, 28% greater power is developed.

The Airetool New Form Cutters eliminates the tendency of cutters to track and damage tubes. This is made possible by an exclusive Airetool development—the periphery of the cutter milled to divide sections of the circumference into teeth of various pitch, as shown in the illustration, which prevents cutter finding the same spot in a tube wall during each revolution.

Airetool Tube Cleaners are offered in a variety of sizes and styles to efficiently and economically meet every tube cleaning problem. Made for tubes ½ in. to 24 in. I.D.; straight or curved.

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AIRETOOL MANUFACTURING COMPANY

Use **VULCODISC**

for trouble-free valve jobs

In renewing the disc, note how easily and quickly the Vulcodisc Jiffy Disc Holder slips off the stem head. Only the disc lock nut to remove and the old disc is off and replaced in a jiffy.

Dense without being brittle—tough, yet resilient, Vulcodisc will not swell, warp or soften—in fact, its absorption is less than 1 per cent. . . . That is why an old Vulcodisc comes out of the disc holder as easily as a new one goes in. No need for hammer and chisel to cut the disc out in pieces—distorting and disfiguring the holder.

THE D. T. WILLIAMS VALVE CO.
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Clipper Masonry Saws provide fast, economical cutting of special sizes and shapes of Clay, Chrome, Silica, Magnesite, Sillimanite, Acid Brick and other refractories.

Precision cuts easily made, assuring tighter joints and longer lasting walls and arches in furnaces and kilns. Greater salvage of obsolete materials made possible through use of this equipment.

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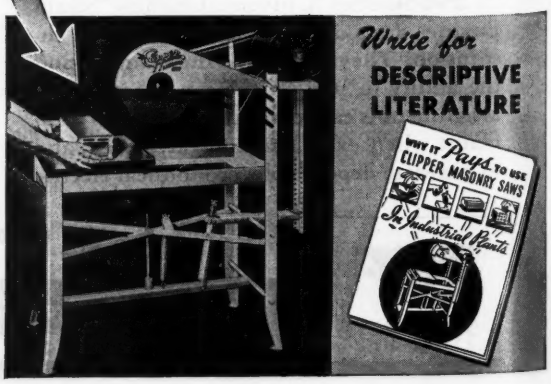
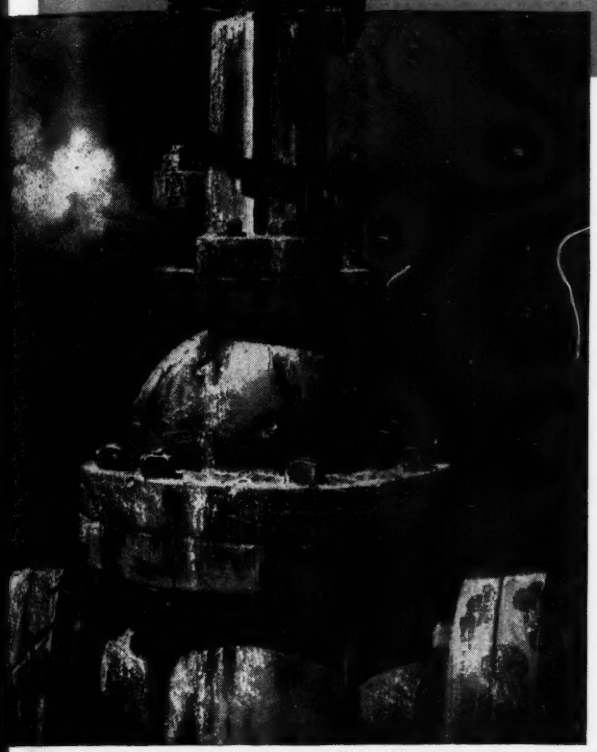
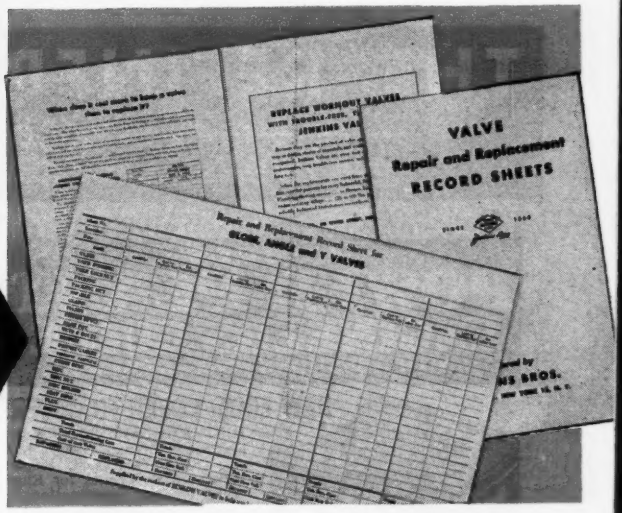


How many "DEADBEAT" VALVES are hiding out on your pipelines?



Jenkins Valve Record Sheets give you practical help in spotting the chronic cost-boosters

Restoring the pipe-lines of industry to top efficiency for peacetime operation is the big job ahead for plant and building engineers. Recognizing your problem, Jenkins Bros. offers practical help that will simplify your checkup of valve equipment and save you time... *Jenkins Valve Record Sheets.*



Send for this sample kit of JENKINS VALVE RECORD SHEETS

See how they simplify the troublesome job of keeping useful valve records. By jotting down the necessary data on these simplified "score sheets", you get a clear, complete picture of a valve's fitness for further use. Tells you at a glance whether repair will be economical, or replacement is advisable.

Kept over a period of time, these records will provide a reliable history of valve performance, and will prove valuable for reference whenever it is necessary to demonstrate the poor economy of nursing along worn out valves.

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For trouble free, time-defying replacements, choose Jenkins Valves

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For every Industrial, Engineering, Marine, Plumbing-heating Service... In Bronze, Iron, Cast Steel and Corrosion-resisting Alloys... 125 to 600 lbs. pressure.

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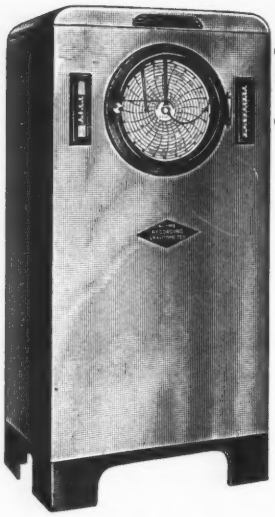

Gravitometer Recorder-Controller, description and prices on application.

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Accurately Records Specific Gravity of Gas

The improved AC-ME RECORDING GRAVITOMETER has been designed with a primary consideration for accuracy which has been obtained by simple and sturdy construction.

OUTSTANDING FEATURES

- **Is sensitive to all changes of specific gravity, giving an accurate record which insures the correct measurement of gas.**
- **Is automatically compensated for atmospheric temperature and barometric pressure variations.**
- **Requires comparatively small quantity of sample gas passing through the instrument and the record is continuous.**
- **Is indispensable where the specific gravity of gas is fluctuating.**

Due to the simplicity of its operation there is a minimum amount of maintenance required to keep the AC-ME RECORDING GRAVITOMETER functioning accurately.

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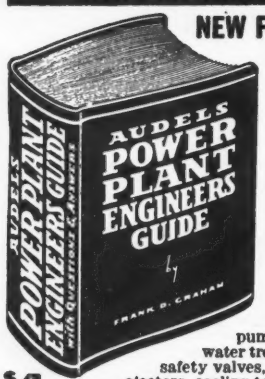
AUDELS

POWER PLANT ENGINEERS GUIDE

WITH QUESTIONS AND ANSWERS



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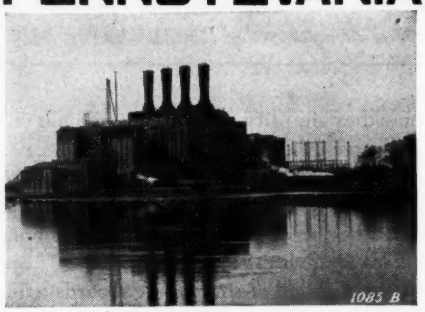

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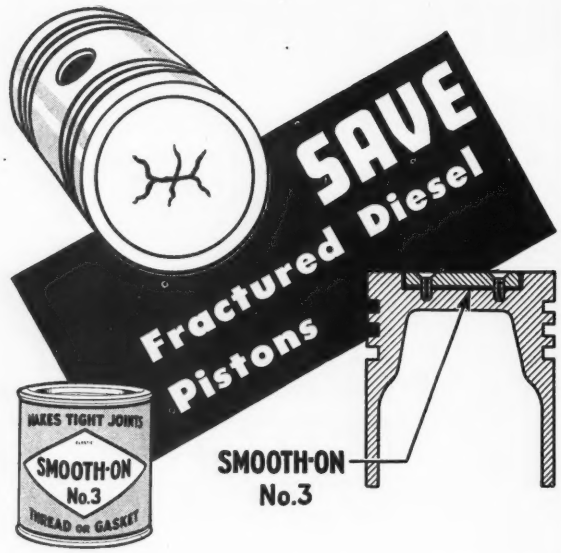

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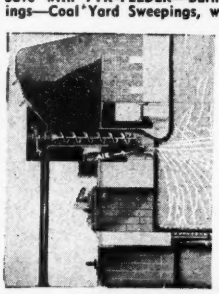

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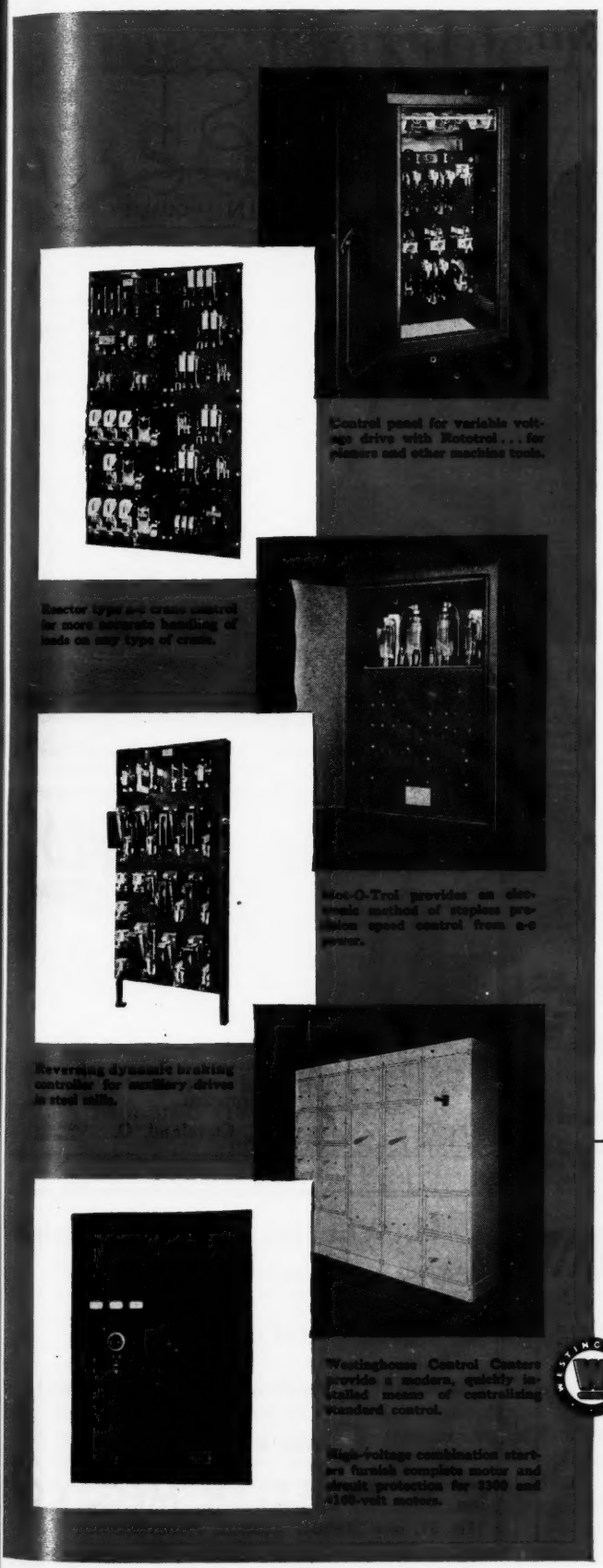

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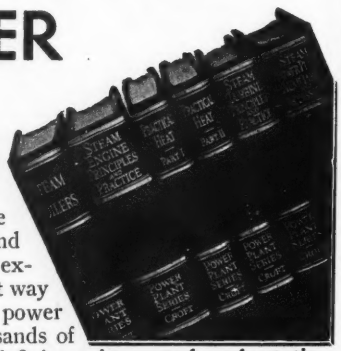

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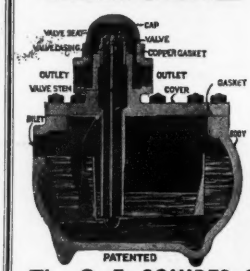

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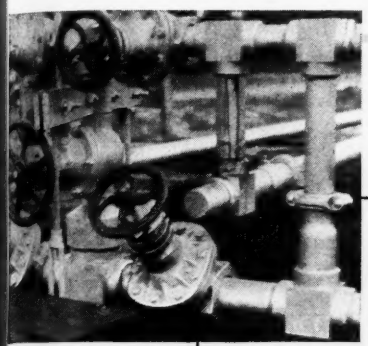

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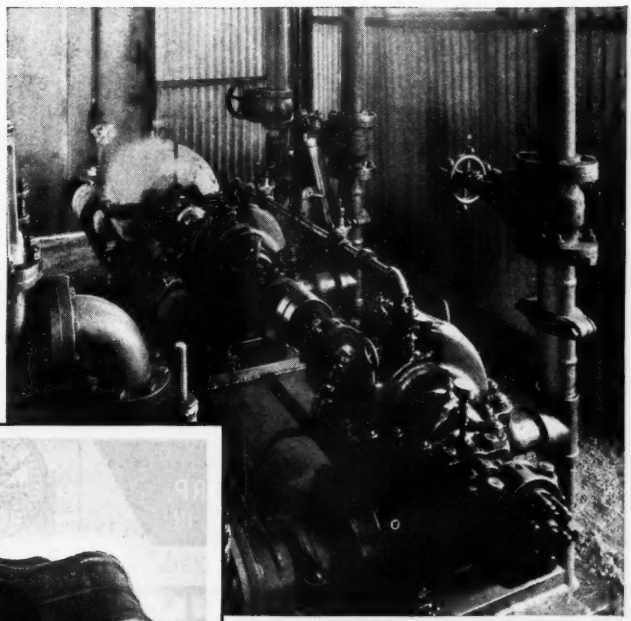

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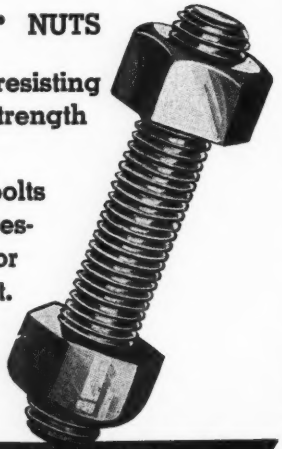

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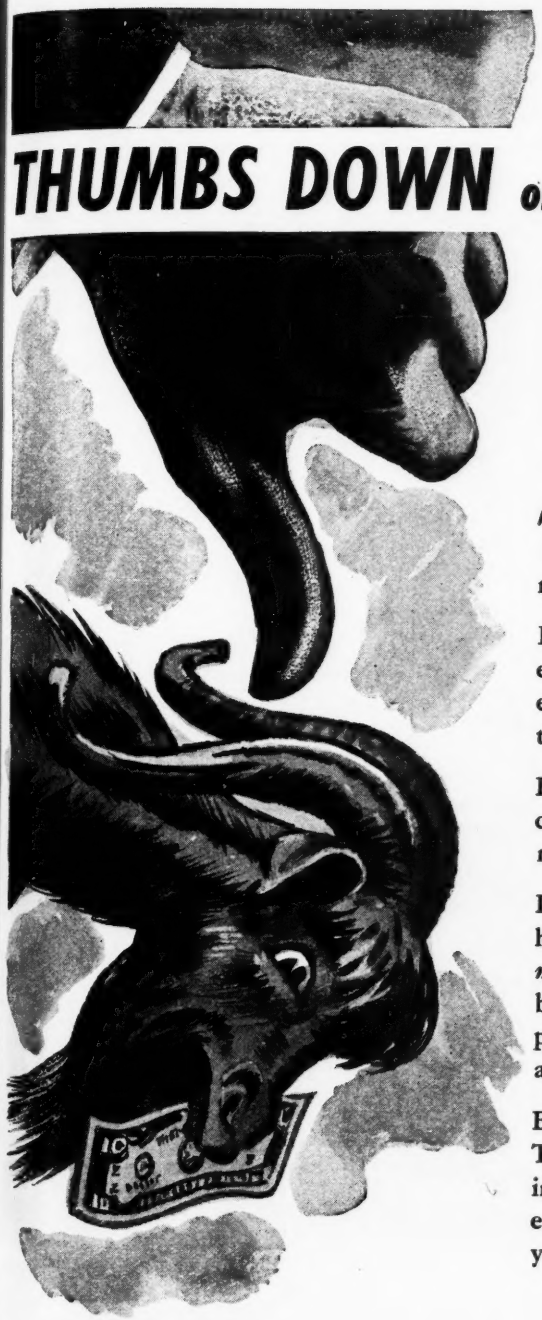

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Installed in New
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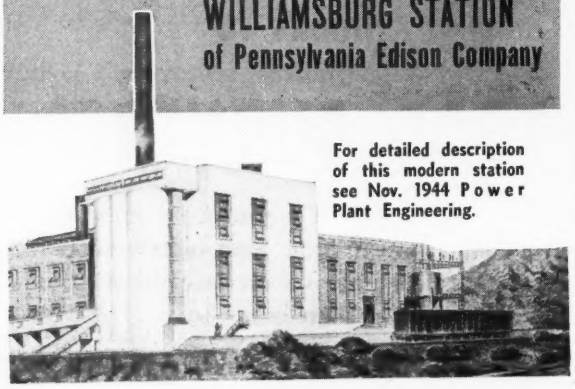

For detailed description of this modern station see Nov. 1944 Power Plant Engineering.

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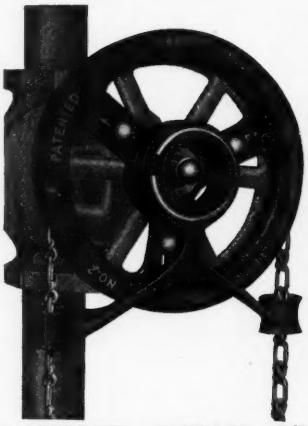

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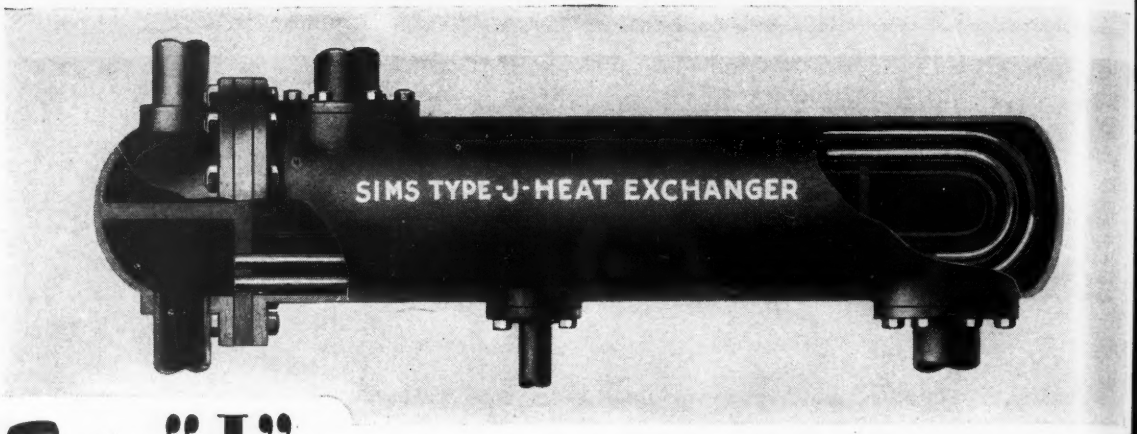

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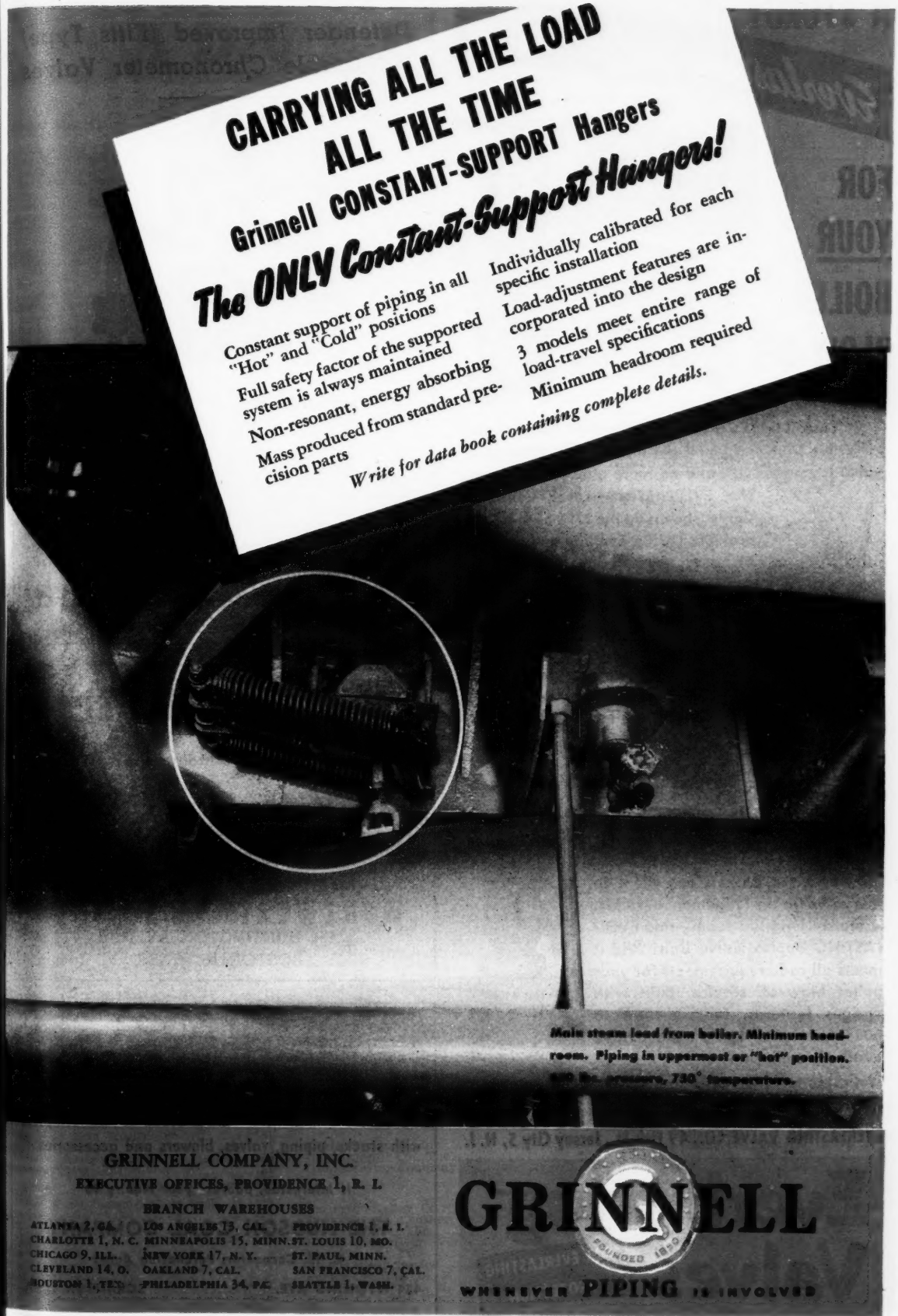
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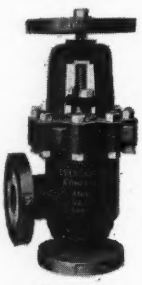

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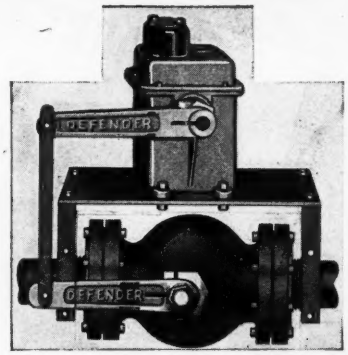

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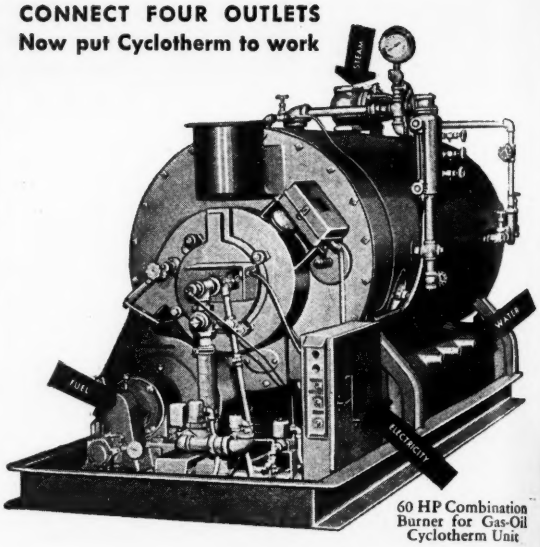

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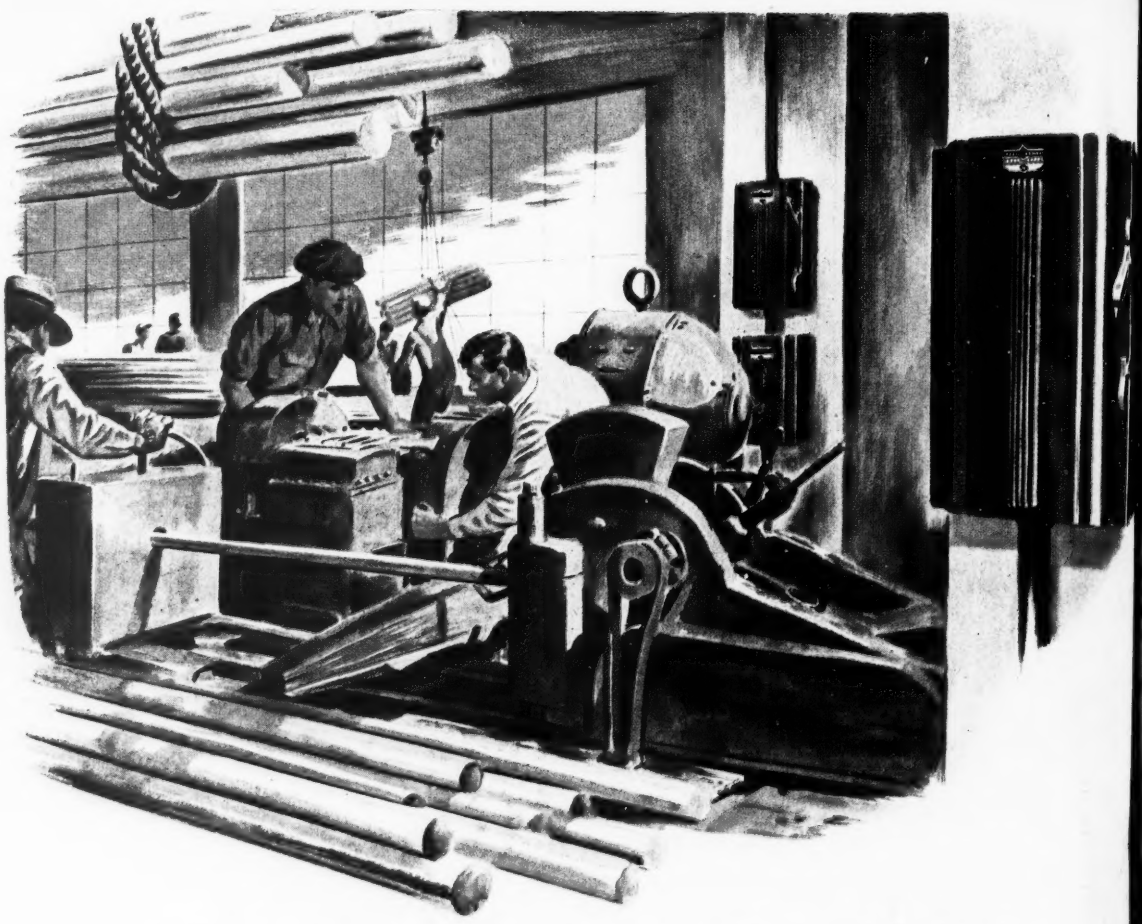

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